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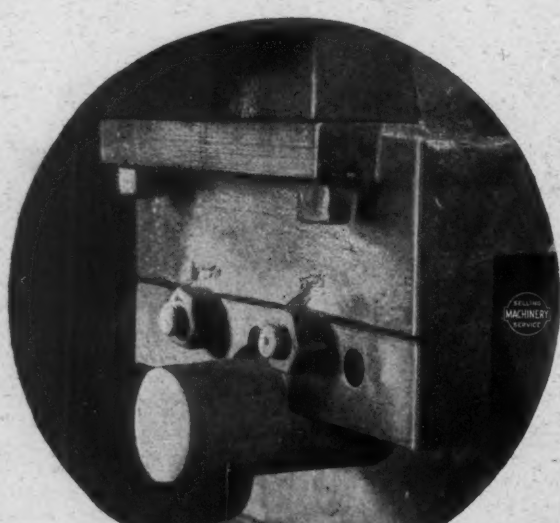

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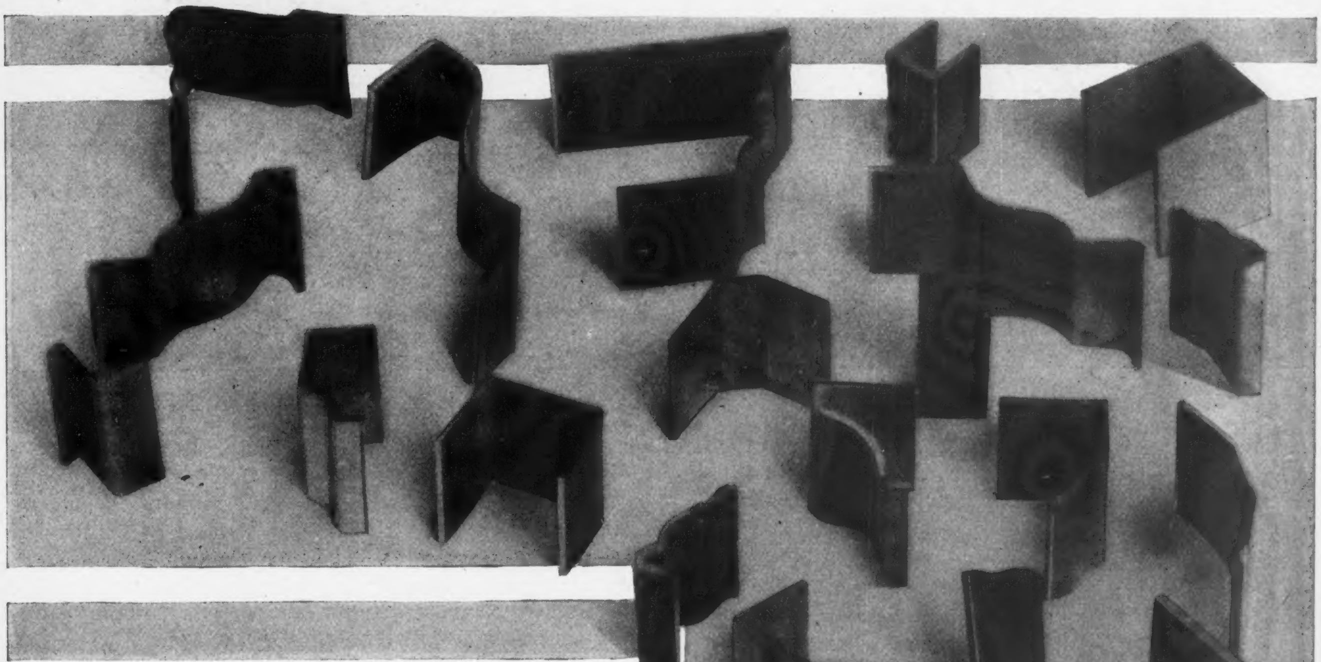

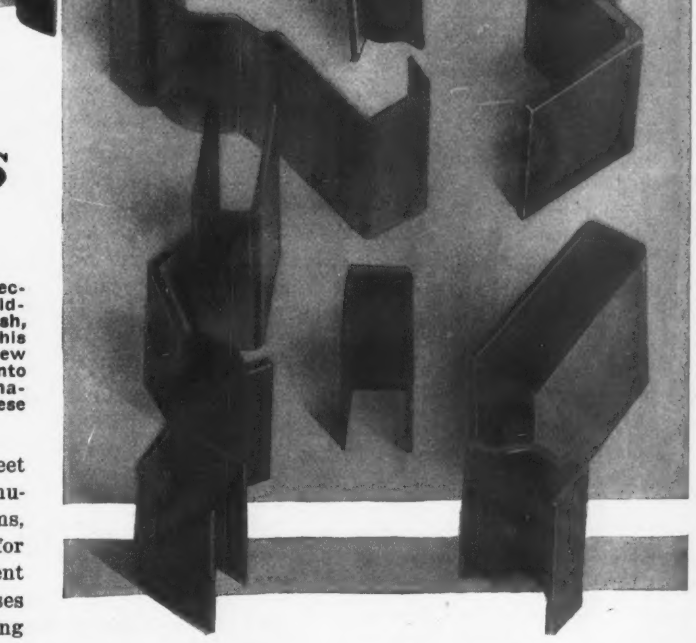

Channeling and Channeling Machines

Chester L. Lucas

With the general enactment of more stringent laws for protection against fire and the consequent construction of fireproof buildings, there has arisen a widespread demand for steel window sash, window frames, doors, moldings and even steel furniture. This demand has resulted in the development of what is virtually a new industry in sheet metal working—the forming of sheet metal into hollow sections of varied cross-sectional shapes by channeling machines, of the rolling mill type. The design and operation of these machines are treated in the present article.

FOR THE formation of irregular sections of sheet metal of indefinite length for use in the manufacture of metal furniture, automobile rims, show cases, etc., in the small sizes, and for structural steel work, gutters, molds for cement forms, steel car manufacture and kindred uses in the larger sizes, the process of rolling or channeling is being largely developed. Sheet stock of any metal may be formed cold by channeling, and any thickness up to one-quarter inch may be worked without difficulty. The speed at which this class of work is handled varies from fifty to ninety feet per minute, according to the metal and the shape to be produced. It is the purpose of this article to describe some of the principles involved and the type of machinery used in this interesting process. Much of the information was supplied by Kane & Roach of Syracuse, N. Y., who are the builders of the machines illustrated in this article.

Characteristics of Machinery for Channeling

Fig. 1 shows a typical channeling machine, with sections of stock as it appears at each stage of the channeling. Fig. 4 is a side view of the machine that shows the rolls to better advantage, and Fig. 7 shows the driving side of the machine with the gear guards removed. Fig. 2 shows a typical channeling job being done on a four-roll machine. Generally speaking, a machine for channeling has two or more pairs of steel rolls—when the shape is particularly intricate the number sometimes runs as high as twelve or fourteen pairs. These rolls are spaced at equal distances along the machine, and each pair gives the metal strip a bend that is slightly more pronounced than that given by the preceding pair. The rolls are geared together and are driven by connecting gears so that each pair helps to drive the sheet forward as well as to form it. On Kane & Roach machines the rolls are always of the overhanging type, that is, the forming rolls operate on the outside of the machine housing. This permits changing them without difficulty when it is desired to produce different sections. In addition, the work is more readily reached and controlled than would be possible if the rolls were within the housings. Adjustable outer bearings are fitted to the outer ends of each pair of rolls, tying the upper and lower shafts together so they cannot spring apart under the pressure. In very heavy channeling machines, the outer shaft bearings are connected in the horizontal direction as well. Fig. 3 shows a section through a rolling machine and illustrates the construction points here described. The gears for driving the rolls are made of steel in order that they may have the necessary strength. The driving gear is always located as near the center of the machine as possible in order to distribute the strain on the roll gears. In view of the fact that vertical ad-

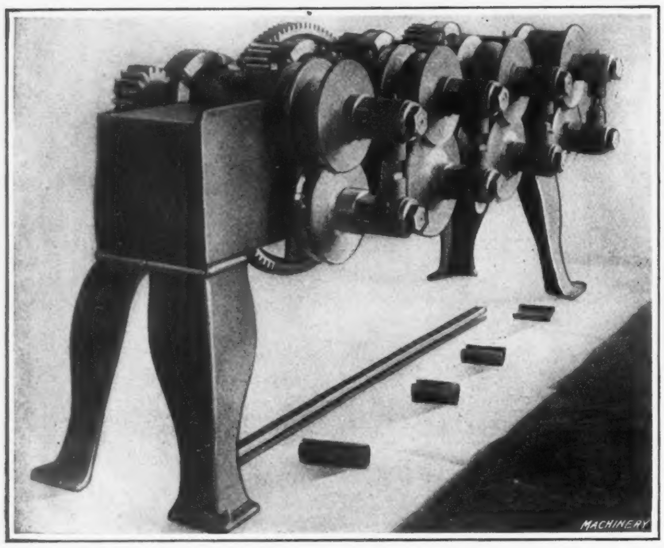

Fig. 1. A Typical Channeling Machine

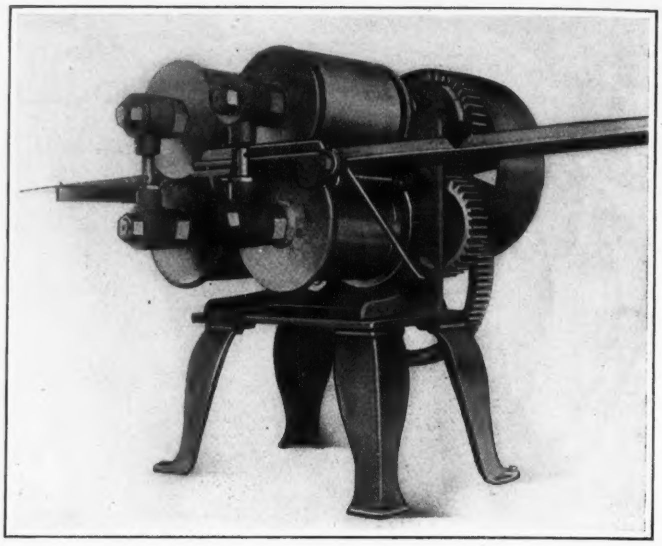

Fig. 2. Four-roll Channeling Machine

justment of the rolls is often necessary, the gear teeth must be cut fairly long to allow considerable latitude in meshing. The vertical adjustment is made possible by mounting the upper roll bearings in eccentric adjustable sleeves. The drive is always to the lower roll first in order to keep the gearing as compact and as low down on the machine as possible. Between each pair of channeling rolls there must be intermediate rolls or guides to carry the stock properly to the next pair of rolls. In order to start the stock correctly, so that it will not start off center or on a slant, a long table or guide is provided before the first pair of rolls. The design of these parts and their functions will be touched upon later.

The Rolls for Channeling

Except for the very smallest and lightest work where there are delicate shapes to be produced, the rolls for channeling machines are made from 0.80 carbon steel castings. When the size and shape permit, they are cored out. The rolls are turned to the finished shape, and after hardening are ground. In the case of delicately shaped or small work, tool steel is used, which is hardened, and afterward ground and shaped even more carefully than is necessary on the larger sized work.

The dimensions and proportions of channeling rolls cannot be laid down by any arbitrary rule, but depend on the depth of the bend and the thickness of the stock. In general, the ideal condition is to have the rolls as small as practical, still maintaining the strength necessary for mounting the rolls properly. Kane & Roach channeling machines are made standard, so that rolls for different sections may be used on the same machines. On these machines the distances between roll centers are arbitrarily fixed; on the machines shown they are from sixteen to twenty inches, which would make the roll diameter about eight or ten inches.

It should be borne in mind that the smaller the roll diameter, the less will be the grip of the rolls on the metal for driving purposes. This is an important point, as it is sometimes hard to secure a sufficient grip on the stock for driving it through the rolls, especially when the channeling section is a difficult one to produce. This is especially true when it is necessary to form metal strips that have been perforated before channeling. In such cases, the amount of metal left for the rolls to obtain a grip on is limited and it is sometimes necessary to throw fine sand on the stock as it is going through in order to make the rolls "take hold." Under no circumstances is a lubricant used, as it would destroy the driving power of the rolls.

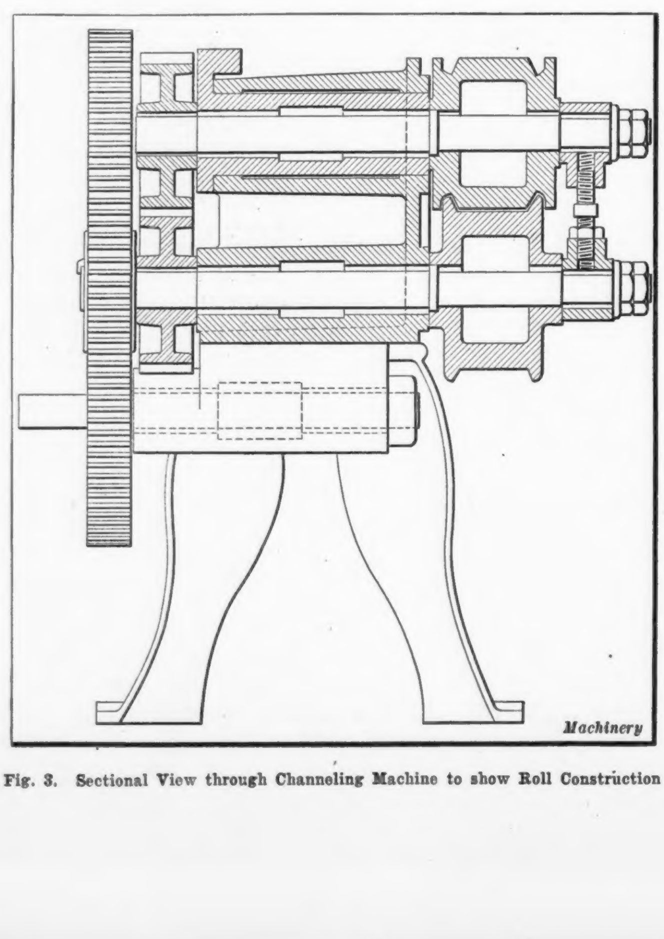

Fig. 3. Sectional View through Channeling Machine to show Roll Construction

Guiding the Stock

The metal to be formed by channeling must be kept under perfect control by guides before it enters the first pair of rolls, and while it passes from one pair of rolls to the next; it must also be guided or straightened after it emerges from the last set of rolls, to counteract the tendency to curl.

It is not necessary to have straightening rolls before the first set of rolls, as the latter are sufficient to remove any kinks or irregularities from the strips, but whenever the shape to be produced can be secured without the help of the first pair of rolls, they should be used perfectly straight as feed rolls. These assist in starting and driving the stock into the first pair of forming rolls. In fact, this feature is absolutely necessary when the metal is so thick that it cannot be readily started into a pair of rolls that will give it the first slight form. When thin stock is to be channeled, it is often possible to fit a pair of forming dies in advance of the first forming rolls, whose function it is to shape the end of the strip so it will enter the rolls easily. These dies are operated by foot-pressure, and the attachment may be seen at the right in Fig. 4. In this manner it is often possible to eliminate the pair of feed rolls at the start.

It is essential to start the stock absolutely central and straight, and for this purpose a long table guide is fitted at the front of the machine. This facilitates starting the strip, and when it has once entered correctly between the first rolls it will retain its alignment unless there is some serious defect in the channeling rolls.

Between each pair of channeling rolls, there must be

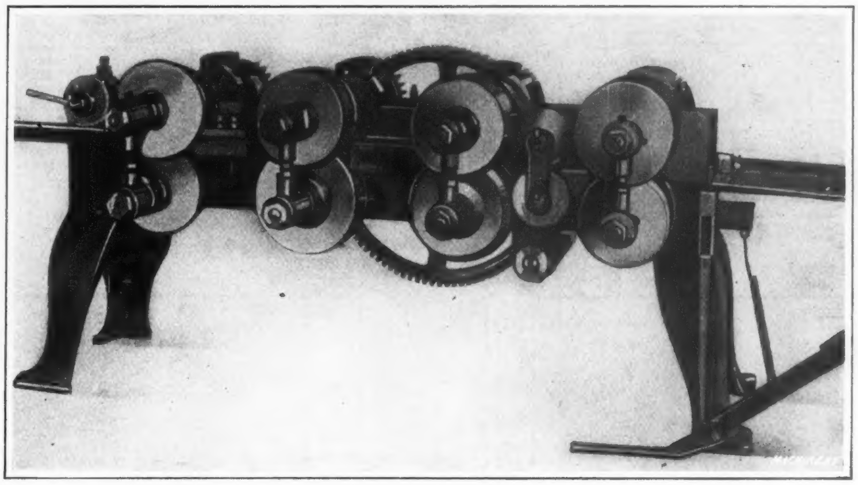

Fig. 4. Eight-roll Channeling Machine as viewed from Roll Side

means for guiding the stock to the next set of rolls, as mentioned. The usual method of doing this is to provide guides in the form of enclosed boxes in which the stock fits fairly close, which give it the proper direction to enter the next pair of rolls. Fig. 2 illustrates this type of guide. Sometimes however, smaller rolls are used for guiding the partly channeled stock in place of the solid guides, and in addition to guiding the stock these intermediate rolls are always made to help in forming the stock as it passes through. In every case, these intermediate rolls are "dead," merely rotating under contact of the stock. The machine in Fig. 4 illustrates both the guides and intermediate rolls. Intermediate rolls are used between the first and second pairs of channeling rolls at the right-hand end of the machine, and the guides are used between the other pairs.

At times, the shape of the section is such that it cannot be formed with rolls operating in one plane only; that is especially true when the section is deeply undercut. In such cases, side rolls are employed that operate in the opposite plane. These are located in the same manner as the intermediate rolls except that they are turned at right angles and do pressing-in operations on the sides of the stock.

It was also mentioned that, in order to produce accurate work, it is necessary to have a straightening roll at the end of the channeling machine to guide the stock as it leaves the last pair of rolls. On almost every channeling operation there is a tendency for the formed strip to curl either upward or downward, depending on the shape, as it emerges from the machine. To obviate this, a small roll, formed to fit one face of the finished stock, is fitted on the machine, following the last pair of rolls, either above or below the stock as found necessary. Fig. 4 shows a machine with the guide roll above the stock line. When properly applied one roll is sufficient to hold the metal straight, delivering the channeled strip in a perfectly straight condition.

In the case of channeling stock for hoops or rims of any kind, it is sometimes possible to put a bending attachment on the end of the channeling machine, as shown in Fig. 10, so that as the stock runs through the last pair of rolls it enters the bending rolls and is formed into the required circle. In this case, the stock cannot be run through in indefinite lengths, but each strip must be cut to the proper length for rolling into a ring of the required diameter before it is fed to the machine.

Laying Out the Rolls for a Channeling Machine

Before taking up the actual laying out of a set of rolls for channeling a given section, it may be well to study Fig. 5, which shows a few typical channeled sections and will help in illustrating the possibilities and principles involved. The different examples are shown in stages, each representing the work done by each pair of rolls on the machine. For instance, the three pieces on the upper line can be produced on machines like that shown in Fig. 2, having two pairs of channeling rolls. Those at the center of the illustration are typical of work that can be handled on machines having three pairs of rolls. The work on the lower line was done with channeling machines having four pairs of rolls, similar to that shown in Fig. 4. These examples are, of course, elementary but they give an idea of what channeling machines with two, three and four pairs of rolls can do. More difficult sections would require machines carrying a greater number of channeling rolls.

In laying out a set of channeling rolls, there are several general observations to be followed, irrespective of the shape of section to be produced. In addition, there are special lines of procedure to be followed in meeting the many conditions that must be taken into consideration. In order to make these points perfectly clear, they will be taken up in detail in the text and references will be made to Figs. 6, 8, and 9, that show the construction of sets of channeling rolls that have been made by Kane & Roach. Taking, first, the set of rolls for a four-roll machine, which as a matter of fact, were made for the machine illustrated in Fig. 2, and from the dimensions in Fig. 6, it will be possible to get an idea of the proportions and general characteristics of these rolls. In this particular instance, the channeled strip was very wide, and as the centers of the rolls had practically no work to do, cast iron was employed, but at the edges where the actual channeling was done steel was employed. The first bend in the

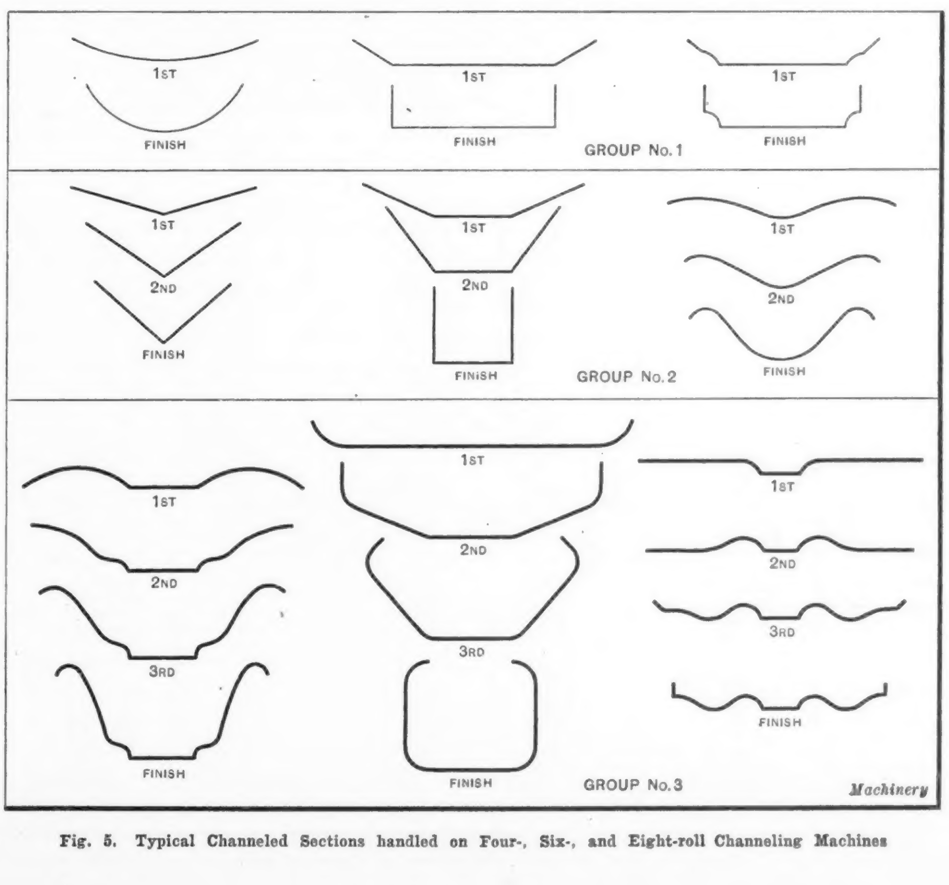

Fig. 5. Typical Channeled Sections handled on Four-, Six-, and Eight-roll Channeling Machines

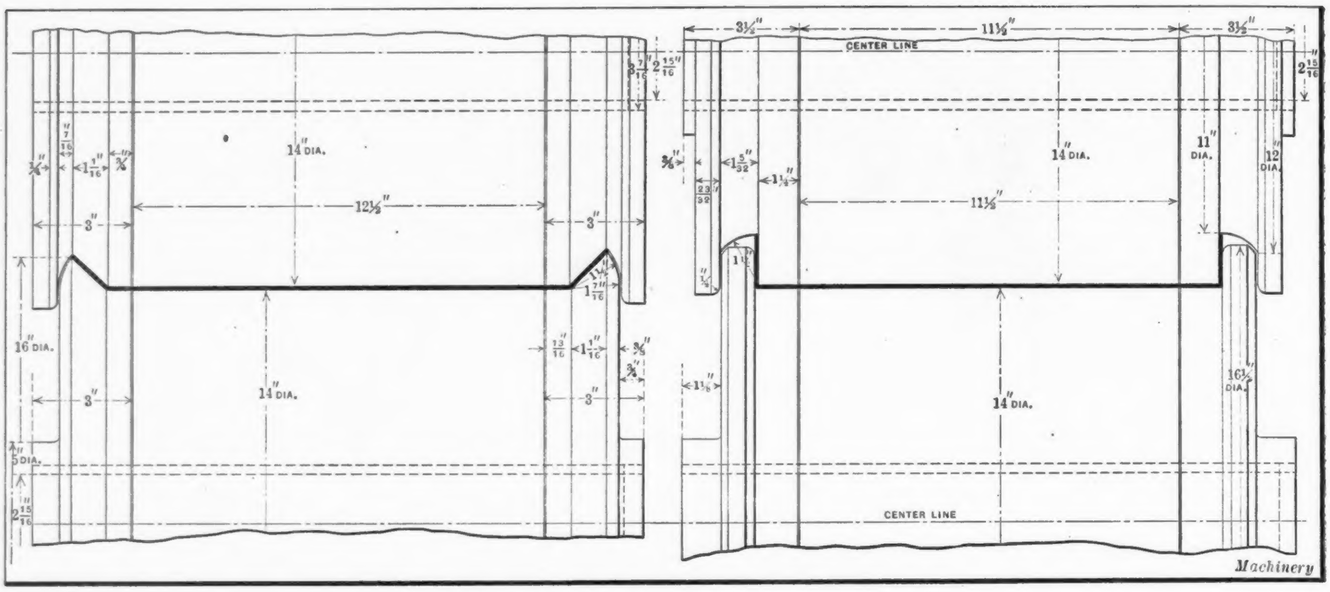

Fig. 6. Rolls from Channeling Machine illustrated in Fig. 2

stock carried the edges up to an angle of about 45 degrees, and the second pair of rolls squared up the bends, leaving them in the finished condition shown by the solid section between the rolls.

A more elaborate job, although similar in general shape, is the one that was performed by the rolls illustrated in Fig. 8. In this case eight rolls were used, the first pair being used as feeders. At the second pair the edges of the stock are thrown up to an angle of 30 degrees from the horizontal. At the third pair, the bending is continued, bringing the edges up to a 60-degree angle from the horizontal, and the fourth pair completes the right-angle bend on the strip.

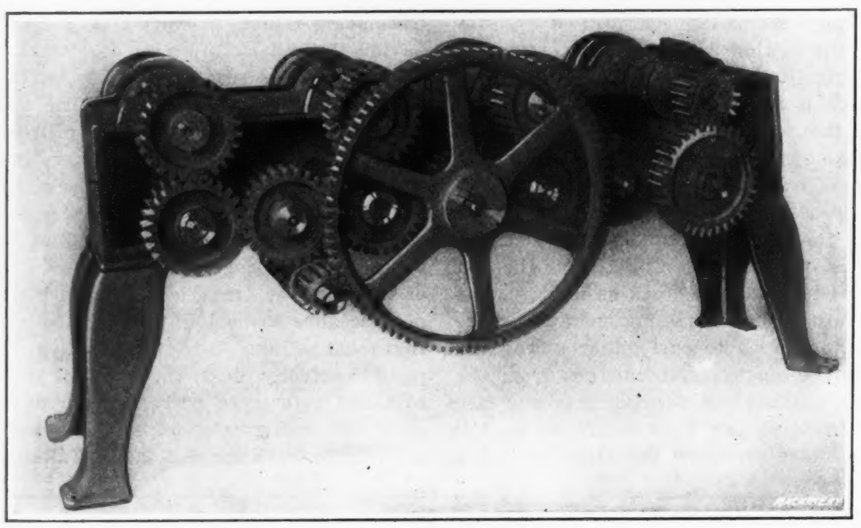

Fig. 7. Eight-roll Channeling Machine as viewed from Driving Side

In this case it will be noticed that cored rolls were employed, as the strain on the rolls was not great.

The sets of rolls shown in section in Fig. 9 are for producing a section of channeling such as would be used for automobile windshield frames or for a similar purpose. This is done on an eight-roll machine as shown in Fig. 1, and the first pair of rolls makes the bends in the sides of the strip; the second pair starts the formation of the tube; the third pair closes the ends as far together as possible, still supporting the work from the inside, while the fourth pair completes the tube, working from the outside of the stock altogether.

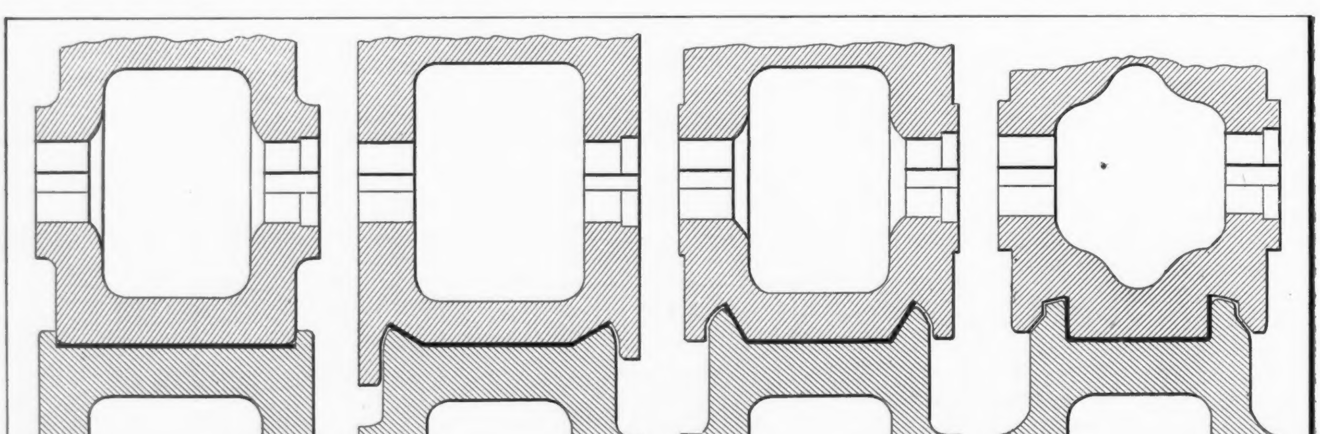

Fig. 8. Roll Sections for producing a Channeled Strip

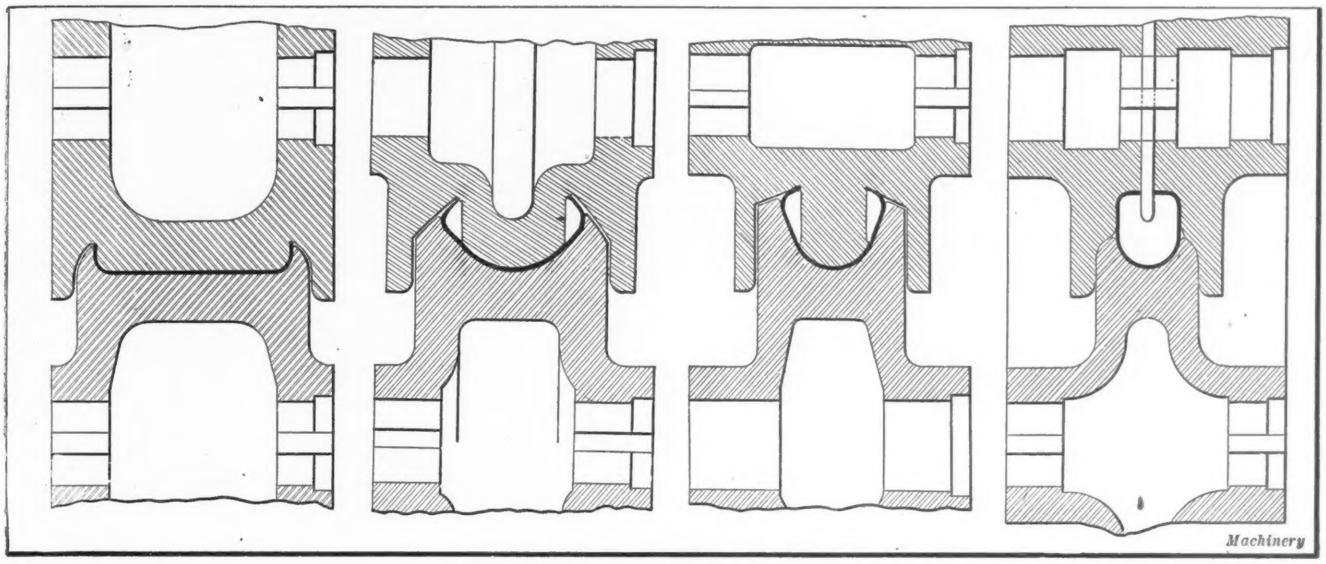

Fig. 9. Roll Sections for channeling a Tube

The channeling forms cut into the rolls should be so proportioned and spaced that the stock will follow as nearly a straight line as possible from the flat sheet to the finished section. This rule applies to the progression of the stock in the vertical plane as well as in the horizontal plane. This means that the transformation of the channeled section from one pair of rolls to the next must follow predetermined lines, and the method of ascertaining how much the change shall be in each case is graphically shown in Fig. 11.

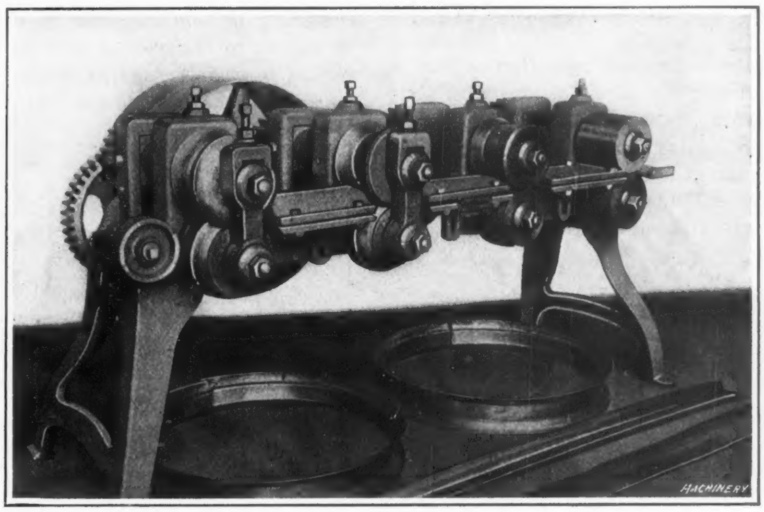

Fig. 10. Channeling Machine equipped with Bending Attachment for rolling Rims

In this view the development of both planes of the section is shown, as effected by a channeling machine with five pairs of rolls. By indicating the width of the stock required for the development of the section as at *A*, and the completely formed section as at *E*, and connecting the extremes as shown, the lines that the stock should follow in the course of the channeling operation will be obtained. The condition of the strip at the feed rolls, if the stock is heavy enough to require feed rolls, will be flat as shown at *A*. The finished condition is shown at *E*, which also shows the form to which the last pair of rolls must be fitted. By subdividing the intervening distance as at *B*, *C*, and *D*, the widths of the forms of the second and third pairs of rolls are ascertained. By the same method, as shown in the lower part of Fig. 11, the depths for the successive roll forms may be found. It should be understood that this method is used only for finding the outside limits of the stock lines and does not apply to the details of the form for each pair of rolls. This will be readily appreciated by referring to some of the examples in Fig. 5, which show that central details of the channeling are often of necessity formed and finished at the first or second stages of the channeling.

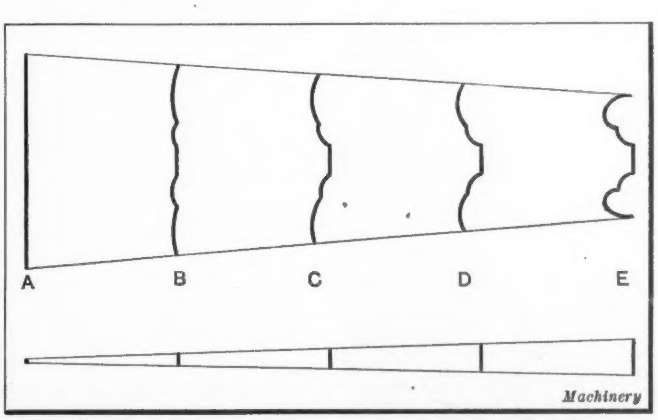

Fig. 11. Diagram illustrating Distribution of Work for Each Pair of Channeling Rolls

Each pair of rolls must have the forms located in the rolls with shoulders or guards at the sides against which the edges of the channeled strip may bear during the rolling process. This construction is clearly illustrated in the rolls represented in Fig. 8. Throughout the contacting surfaces of the rolls the distance between the two rolls must be exactly the same as the thickness of the metal. If this distance is not maintained, there will be a binding or shrugging action on the metal where the rolls are tightest, and the tendency will be not only to channel the stock improperly, but to put a "bow" in the strip as well, thus spoiling it. On each side of the actual contacting surfaces of the rolls, the unused portions are turned off slightly so as to give a clearance between all surfaces not necessary for the channeling. This also allows for making adjustment when the rolls have worn or if it should be necessary to apply more pressure.

One fundamental point in regard to the depth of the forms in the channeling rolls must always be borne in mind. The working center line of the stock should be kept as near to the center line between the two roll axes as possible. The reason for this is obvious, because it will at once be seen that any difference in the working diameters of the two rolls would prevent them from feeding alike, and the rolls would work against each other, sometimes to the extent of breaking the gear teeth. In addition, there would be a constant slipping action all the way through between the stock and the rolls. It is seldom possible to design the rolls so that the velocities of the bearing portions will be equal, but the aim is to approximate that condition. There is no rule that can be set down for the best location of the form in the rolls, but in general terms, the

channeling action should take place as near as possible to the center line between the rolls, as previously stated.

The ideal channeling action is secured when the last pair of rolls turns slightly faster than the others. The last rolls are, of course, the most important, as the metal is finished by the passage through them. By causing them to turn a very little faster than the others, the effect is to constantly exert a slight pull on the strip being channeled. It often happens, however, that these rolls have a tendency toward slower action on account of the deeper contour of the form cut in them. In such cases they must be speeded up by the use of change-gears. This condition is illustrated by the last pair of rolls in the set in Fig. 9, which are from the machine shown in Fig. 1. The rolls turn over the edges of the strip to form a tube. On account of the depth to which the upper roll must be cut to form the section, the contact surface left on this roll is very small in comparison with the contact surface of the lower roll. Consequently, if the speeds of these two rolls were equal, a great deal of slipping would take place. To overcome this difficulty, the upper roll is speeded up with change-gears to secure a uniform surface speed. Channeled stock must, of course, be cut to length by sawing, as shearing would destroy the shape.

For the formation of work that is to be subsequently bent at right angles, the edges of the stock may be notched at the bending points before channeling, so that when it emerges from the channeling machine it will be ready for bending. This was the case with the channeling job shown in Fig. 2, in which the notches may be seen. In the same way, punching, slitting or piercing operations may be conducted previous to channeling.

The great advantage of the channeling operation is that it is continuous—the shapes being produced as long as strip stock is supplied to the machine. Compared with press-working, a great saving of time and material is effected as the machine has no idle moments. On the whole, channeling is an extremely interesting process, and one which, though still in its infancy, clearly has great possibilities.

* * *

A LARGE BROACHING JOB

The W. W. Oliver Mfg. Co. of Buffalo, N. Y., has made several sizes of jewelers' rolling mills for a number of years. In the right-hand lower corner of Fig. 1 may be seen the castings for three sizes of housings for these rolls. The machining of these housings includes the finishing of the slots in which the roll bearings slide and also the finishing of the inside faces that limit the end play of the rolls. It is plain that if the rolls are to work properly these surfaces must be finished accurately and, above all, the cuts must be parallel.

Until the method of machining described in the following was adopted, this work was accomplished by milling, but it was slow, requiring an average of two and a half hours to finish each housing and the employment of an awkward extension milling rig that reached through the housing.

Fig. 1 shows how the job is successfully handled in one-tenth of the milling time, on a Lapointe Machine Tool Co.'s broaching machine.

Fig. 1. Broaching Housings of Jewelers' Rolls

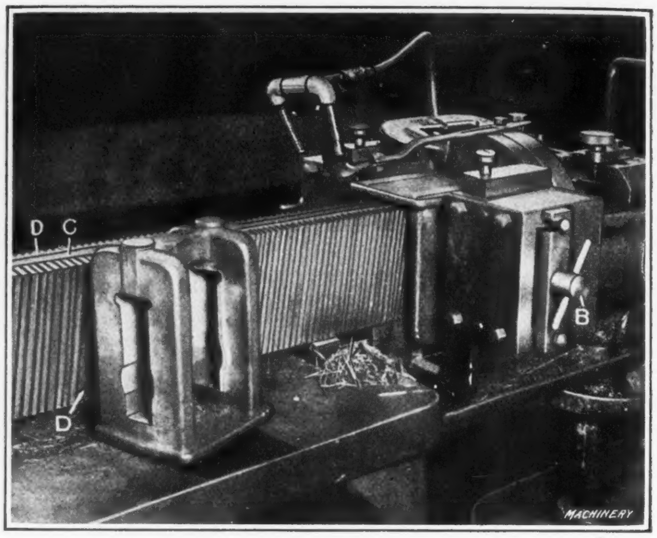

Fig. 2. Close-range View of Broach and Work

Fig. 2 was taken at close range and shows how the work is held for broaching. In the latter illustration the faceplate fixture for holding the housing may be seen, and in Fig. 3 the construction of the broach and the method of supporting the work are shown. The entire job is completed in two broaching cuts; one through the work, as shown in the illustrations, and the other at right angles through the slots in the housing sides. As shown in Fig. 3, the work is held in place by clamping tongues *A* that may be run in to engage the slots at the sides by means of hand-screws *B*. The broaching operation is performed in the usual manner, and after the lot of housings has been broached in one direction a faceplate is put on the machine to hold the work for taking the cut in the other direction.

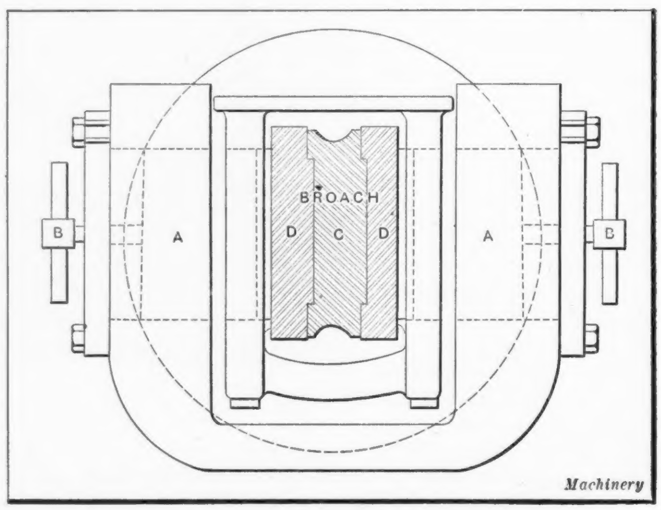

Fig. 3. Broach Section and Details of Work Support

The slots in the housings are broached with solid broaches, but the other operation is done with a built-up broach as shown by the section in Fig. 3. This broach, if made solid, would require a very heavy and expensive piece of tool steel and, moreover, as various sizes of housings must be finished, it was decided to make each broach cover as many sizes as possible. To this end, the broaches are made in halves, permitting the insertion of filler-blocks of different thicknesses between the halves when wide cuts are to be made. Thus, in Fig. 3, filler-block *C*, of machine steel, separates the halves of the broach to the required size for broaching the housing shown. By substituting thicker or thinner filler-blocks, larger or smaller sized housings may be handled with the same broach. In the top and bottom faces of the filler-block are grooves that engage guide-blocks in the head of the machine, and thus the action of the broach is effectively controlled. The average machining time for finishing the housings by this method is fifteen minutes, as contrasted with two hours and a half for milling. C. L. L.

TOOL STEEL TRADE-NAMES

COMPILATION OF DISTINCTIVE BRANDS OF TOOL AND HIGH-SPEED STEELS

PRIOR to the discovery of high-speed steel by Messrs. Taylor and White in the late nineties, there were well-known brands of carbon tool steels, some of which dated back over fifty years. Since that epoch-making discovery many more brands of high-speed steel and carbon tool steel have been placed on the market. Generally these brands are copyrighted trade-names that are distinctive, catchy, or suggestive of high efficiency, but few are self-identifying as the product of the makers. We have often been asked for the names of makers or general sales agents of this, that or the other brand of steel, and have felt the need of a comprehensive directory of these peculiar trade-names. The following list of distinctive and copyrighted names of carbon tool steel and high-speed steel has been compiled from information furnished by the American steel makers and the general sales representatives of brands of carbon steel and high-speed steel sold in America. It has been the intention to include only the names of the American makers, or in the case of foreign steels, the names of the general agencies. In a few cases it has seemed necessary to give both the name of the maker and the general agency. The list is incomplete in the sense that many names have been omitted which could not be regarded as distinctive, such as "Standard," "XX," "Special," "Extra," "Double Extra," etc. But on the other hand some in the doubtful class have been given here because only one concern in each case is using them.

Brand	Maker or Agent
A B C Special	Darwin & Milner, Inc., New York.
Ajax	B. M. Jones & Co., Inc., Boston, Mass.
Albany	Ludlum Steel Co., Watervliet, N. Y.
Albion	Hobson, Houghton & Co., Ltd., N. Y.
Alva	Crucible Steel Co. of A., Pittsburg.
A M C	A. Milne & Co., New York.
Anchor	Colonial Steel Co., Pittsburg, Pa.
Argo	John Illingworth Steel Co., Phila., Pa.
Ark	Wm. Jessop & Sons, Inc., New York.
Arrow	John A. Crowley Co., New York.
Atha	Crucible Steel Co. of A., Pittsburg.
Atlas	Atlas Cr'c'ble Steel Co., Dunkirk, N. Y.
Austenite	Milnor & Goedman, New York.
Austenite Excelsior	Milnor & Goedman, New York.
Aust. Excel. Superior	Milnor & Goedman, New York.
A W Special	Firth-St'rl'ng Steel Co., McK'port, Pa.
Beaver	Colonial Steel Co., Pittsburg, Pa.
Bell	Patriarche & Bell, New York.
Bethlehem	Bethlehem Steel Co., S. Bethlehem, Pa.
B F M	Milnor & Goedman, New York.
Black Diamond	Crucible Steel Co. of A., Pittsburg.
Blue Chip	Firth-St'rl'g Steel Co., McKeesport, Pa.
Blue Chip C	Firth-St'rl'ng Steel Co., McK'port, Pa.
Blue Chip Superior	Firth-St'rl'ng Steel Co., McK'port, Pa.
Blue Label	Heller Brothers Co., Newark, N. J.
Bohler Rapid	Houghton & Richards, Boston, Mass.
Braeburn	Braeburn Steel Co., Braeburn, Pa.
Burgess	Cyclops Steel Works, Titusville, Pa.
C	A. Milne & Co., New York.
Canton	Crucible Steel Co. of A., Pittsburg.
Capital*	Edgar T. Ward's Sons, Boston, Mass.
Cello	McInnes Steel Co., Ltd., Corry, Pa.
Ceswic	Central Steel & Wire Co., Chicago, Ill.
Champion	Crucible Steel Co. of A., Pittsburg.
C L	A. Milne & Co., New York.
Clarite	C'l'mb'a Tool Steel Co., Ch'c'go Hts, Ill.
Class E	Edgar Allen & Co., Ltd., Chicago, Ill.
Class P	Edgar Allen & Co., Ltd., Chicago, Ill.
Cobalt	Becker Steel Co. of America, N. Y.
Coco	Colonial Steel Co., Pittsburg, Pa.
Colonial	Colonial Steel Co., Pittsburg, Pa.
Columbia	C'l'mb'a Tool Steel Co., Ch'c'go Hts, Ill.
Comet	Carpenter Steel Co., Reading, Pa.
Crescent	Crucible Steel Co. of A., Pittsburg.
Cromo	Carbon Steel Co., Pittsburg, Pa.
Crown-Razor	Horace T. Potts & Co., Philadelphia.
C S	A. Milne & Co., New York.
Cyclone	Congdon & Carpenter, Pr'dence, R. I.
Cyclops	Cyclops Steel Works, Titusville, Pa.
C Y W Choice	Firth-St'rl'ng Steel Co., McK'port, Pa.
Dana	Dana & Co., Inc., New York.
Dannemora*	Edgar T. Ward's Sons, Boston, Mass.
Darwin	Darwin & Milner, Inc., New York.
Darwin 505 Cobalt	Darwin & Milner, Inc., New York.
Demmler D	Firth-Sterling Steel Co., McK'port, Pa.
Deward	Atlas Cr'c'ble Steel Co., Dunkirk, N. Y.
Diamond	Peter A. Frasse & Co., Inc., New York.
Diamond B	Joseph T. Ryerson & Son, Chicago, Ill.
Disston's	Henry Disston & Sons, Tacony, Phila.
Double Mushet	B. M. Jones & Co., Inc., Boston, Mass.
Dreadnought †	Halcomb Steel Co., Syracuse, N. Y.
D S W	George Nash Co., New York.
Duro Special	Crucible Steel Co. of A., Pittsburg.
Duror	Darwin & Milner, Inc., New York.
Dynamo	Patriarche & Bell, New York.
E H	Ellsworth Haring, New York.
Elba	Ludlum Steel Co., Watervliet, N. Y.
Empire A	Swedish Iron & Steel Co., New York.
Excelsior	Swedish Iron & Steel Co., New York.
F	Ludlum Steel Co., Watervliet, N. Y.
Fearless	Hobson, Houghton & Co., Ltd., N. Y.
F E R	A. Milne & Co., New York.
Finis	Firth-Sterling Steel Co., McK'port, Pa.
Firth's Best	Firth-Sterling Steel Co., McK'port, Pa.
F J A B	A. Milne & Co., New York.
Flying Scotsman	Peter A. Frasse & Co., Inc., New York.
Fort Pitt	Vulcan Cr'c'ble St'l Co., Aliquippa, Pa.
Frasse Electric	Peter A. Frasse & Co., Inc., New York.
F Special	Ludlum Steel Co., Watervliet, N. Y.
Girod	C. W. Leavitt & Co., New York.
Goliath	Krefeld Steel Co., New York.
Green Label	Heller Brothers Co., Newark, N. J.
Gyro	Braeburn Steel Co., Braeburn, Pa.
Gysinge	Electro Steel Co., Pittsburg, Pa.
Halco	Halcomb Steel Co., Syracuse, N. Y.
Halcomb †	Halcomb Steel Co., Syracuse, N. Y.
Hansa	Dilworth Lockwood & Co., New York.
Hawk Brand	Hawkridge Bros. Co., Boston, Mass.
Hecla	Vulcan Cr'c'ble St'l Co., Aliquippa, Pa.
Hidalgo	Hidalgo Steel Co., New York.
Hobson	Hobson, Houghton & Co., Ltd., N. Y.
Hobson's Choice XX	Hobson, Houghton & Co., Ltd., N. Y.
Howe	Crucible Steel Co. of A., Pittsburg.
Howe-Brown	Crucible Steel Co. of A., Pittsburg.
H & R	Houghton & Richards, Boston, Mass.
H S	A. Milne & Co., New York.
Hudson	Baldwin Steel Co., Charleston, W. Va.
Huron	Ludlum Steel Co., Watervliet, N. Y.
I B	A. Milne & Co., New York.
Ideal	Edgar T. Ward's Sons, Boston, Mass.
Ideor	Darwin & Milner, Inc., New York.
Imperial	Edgar Allen & Co., Ltd., Chicago, Ill.
Incassable	Milnor & Goedman, New York.
Inflexible	Milnor & Goedman, New York.
Intra	H. Boker & Co., Inc., New York.
Invaro	Firth-Sterling Steel Co., McK'port, Pa.
I R	Ingersoll-Rand Co., New York.
Iridium Cobalt	Becker Steel Co. of America, N. Y.
Janus	Hidalgo Steel Co., New York.
Jason	Carpenter Steel Co., Reading, Pa.
Jessop	Wm. Jessop & Sons, Inc., New York
J I	John Illingworth Steel Co., Phila., Pa.
J Y	Carpenter Steel Co., Reading, Pa.
K-9	Edgar Allen & Co., Ltd., Chicago, Ill.
Ketos †	Halcomb Steel Co., Syracuse, N. Y.
Keystone	Carpenter Steel Co., Reading, Pa.
Krefeld	Krefeld Steel Co., New York.
Kronos	Peter A. Frasse & Co., Inc., New York.
Krupp	Thomas Prosser & Son., New York.
Kutkwik	Henry Disston & Sons, Tacony, Phila.
K W	Carpenter Steel Co., Reading, Pa.
La Belle	Crucible Steel Co. of A., Pittsburg.
L C T †	Halcomb Steel Co., Syracuse, N. Y.
Loco	Atlas Cr'c'ble Steel Co., Dunkirk, N. Y.
Mansil	Henry Disston & Sons, Tacony, Phila.
Maximum	Peter A. Frasse & Co., Inc., New York.
Midas	Carpenter Steel Co., Reading, Pa.
Midvale	Midvale Steel Co., Philadelphia, Pa.
Minerva	Edgar Allen & Co., Ltd., Chicago, Ill.
Misco A	McInnes Steel Co., Ltd., Corry, Pa.
Modern	Becker Steel Co. of America, N. Y.
Mohawk	Ludlum Steel Co., Watervliet, N. Y.
Monaca	Pittsb'g T'l St'l Wire Co., Monaca, Pa.
Monarch	Schrock & Squires, New York.
Mushet	B. M. Jones & Co., Inc., Boston, Mass.
N C S	H. Boker & Co., Inc., New York.
Neor	Darwin & Milner, Inc., New York.
No. 7	Colonial Steel Co., Pittsburg, Pa.
Novo	H. Boker & Co., Inc., New York.
Novo Superior	H. Boker & Co., Inc., New York.
Oildie	C'l'mb'a Tool St'l Co., Ch'c'go Hts., Ill.
Oneida	Ludlum Steel Co., Watervliet, N. Y.
Paragon	Crucible Steel Co. of A., Pittsburg.

Brand	Maker or Agent
Park	Crucible Steel Co. of A., Pittsburg.
Peerless	Heller Bros. Co., Newark, N. J.
Peerless A	Crucible Steel Co. of A., Pittsburg.
P F	Phila. Steel & Forge Co., Phila., Pa.
P H	Becker Steel Co. of America, N. Y.
Phylex	Darwin & Milner, Inc., New York.
Poldi	Peter A. Frasse & Co., Inc., New York.
Pompton	Ludlum Steel Co., Watervliet, N. Y.
Presto	Carpenter Steel Co., Reading, Pa.
Prima Mosta	Moore Bros., Sharon, Pa.
Prince	A. Milne & Co., New York.
Reading	Carpenter Steel Co., Reading, Pa.
Red Cut Cobalt	Vanadium-Alloys Steel Co., Latrobe, Pa.
Red Cut Superior	Vanadium-Alloys Steel Co., Latrobe, Pa.
Red Star	Colonial Steel Co., Pittsburg, Pa.
Red, White and Blue	George Nash Co., New York.
Regal No. 2	Vulcan Cr'c'ble St'l Co., Aliquippa, Pa.
Rekord Superior	Horace T. Potts & Co., Philadelphia.
Rex	Crucible Steel Co. of A., Pittsburg.
Royal	Milnor & Goedman, New York.
Royal Tool	Milnor & Goedman, New York.
R T	Firth-Sterling Steel Co., McK'port, Pa.
Rushitoff	Fairley-Davidson Steel Co., Inc., N. Y.
Ryolite	Joseph T. Ryerson & Son, Chicago, Ill.
Saben	Halcomb Steel Co., Syracuse, N. Y.
Sanderson	Crucible Steel Co. of A., Pittsburg.
Sandvik	J. Wilckes Co., New York.
Scott's IXL	Bourne-Fuller Co., Cleveland, Ohio.
Scott's Unique	Bourne-Fuller Co., Cleveland, Ohio.
Seneca	Ludlum Steel Co., Watervliet, N. Y.
Silver Steel	Hobson, Houghton & Co., Ltd., N. Y.
Silver Tool	Crucible Steel Co. of A., Pittsburg.
Sisco	Swedish Iron & Steel Co., New York.
Sisco-Acorn	Swedish Iron & Steel Co., New York.
Soderfors Best	Horace T. Potts & Co., Philadelphia.
Soho	Hobson, Houghton & Co., Ltd., N. Y.
Solar	George Nash Co., New York.
Solar High Duty	George Nash Co., New York.
Speedicut	Th's. Firth & S'ns., Ltd., M'treal, Can.
S R B	Halcomb Steel Co., Syracuse, N. Y.
S. & S	Schrock & Squires, New York.
Stag	Edgar Allen & Co., Ltd., Chicago, Ill.
Star	Peter A. Frasse & Co., Inc., New York.
Star Zenith	Carpenter Steel Co., Reading, Pa.
Stellite ‡	Haynes Stellite Co., Kokomo, Ind.
Stentor	Carpenter Steel Co., Reading, Pa.
Sterling	Firth-Sterling Steel Co., McK'port, Pa.
Styrian	Houghton & Richards, Boston, Mass.
Superior	Peter A. Frasse & Co., Inc., New York.
Supreme	Edgar Allen & Co., Ltd., Chicago, Ill.
Talon	Edgar Allen & Co., Ltd., Chicago, Ill.
Titan	Carpenter Steel Co., Reading, Pa.
Titanic	B. M. Jones & Co., Inc., Boston, Mass.
T K	Carpenter Steel Co., Reading, Pa.
Toledo	Jno. Hy. Andrew & Co., Ltd., N. Y.
Toledo Supra	Jno. Hy. Andrew & Co., Ltd., N. Y.
Trinity Tone	Westmoreland Steel Co., Gr'ns'b'g, Pa.
Triple Life C D	Darwin & Milner, Inc., New York.
Trojan	Horace T. Potts & Co., Philadelphia.
U B A S	George Nash Co., New York.
Ultissimus	Electro Steel Co., Pittsburg, Pa.
Ultra Capital*	Edgar T. Ward's Sons, Boston, Mass.
Ultra-Rapid	Electro Steel Co., Pittsburg, Pa.
U. S	Brown & Co., Inc., Pittsburg, Pa.
Utal	Darwin & Milner, Inc., New York.
V	McInnes Steel Co., Ltd., Corry, Pa.
Vasco Choice	Vanadi'm-Alloys St'l Co., Latrobe, Pa.
Vasco Electric	Vanadi'm-Alloys St'l Co., Latrobe, Pa.
Vasco Ideal	Vanadi'm-Alloys St'l Co., Latrobe, Pa.
Vasco Latrobe	Vanadi'm-Alloys St'l Co., Latrobe, Pa.
Vasco Marvel	Vanadi'm-Alloys St'l Co., Latrobe, Pa.
Vasco Non-Shrinkable	Vanadi'm-Alloys St'l Co., Latrobe, Pa.
Vasco Special	Vanadi'm-Alloys St'l Co., Latrobe, Pa.
Velos	F. R. Phillips & Sons Co., Phila., Pa.
Velox	Atlas Cr'c'ble St'l Co., Dunkirk, N. Y.
Victor	Crucible Steel Co. of A., Pittsburg.
Victoria Gluckenstahl	Johnson & Co., St. Louis, Mo.
Victory	Hy. Rossell & Co., Ltd., Chicago, Ill.
Viking	Crucible Steel Co. of A., Pittsburg.
Vulcan	Vulcan Cr'c'ble Steel Co., Aliquippa, Pa.
Wardlow's Tough	S. & C. Wardlow, New York.
Warranted Best	Hobson, Houghton & Co., Ltd., N. Y.
Wesco	Braeburn Steel Co., Braeburn, Pa.
Weto	Carbon Steel Co., Pittsburg, Pa.
Wolfram	Vulcan Cr'c'ble Steel Co., Aliquippa, Pa.
Wolfram Cobalt	Vulcan Cr'c'ble St'l Co., Aliquippa, Pa.
Xtof	Fairley-Davidson Steel Co., Inc., N. Y.
Xtrusion	Fairley-Davidson Steel Co., Inc., N. Y.
Yellow Label	Heller Bros. Co., Newark, N. J.
Zenith	Carpenter Steel Co., Reading, Pa.

* Also sold by the George Nash Co., New York.
† Sold by Hawkridge Bros., Boston, Mass.
‡ Stellite is not a steel, but a chromium-cobalt alloy.

LUBRICANT IN GRINDING

Some interesting facts on lubricants used in grinding are given in the December number of *Grits and Grinds*, in an article by Howard W. Dunbar of the Norton Grinding Co. He states that the term "lubrication of the work" may be a misnomer in grinding, as the use of grinding compound, oil, soda water or even clear water flowing on the work at the point where the grinding wheel comes in contact with the work being ground is known as lubrication of the work. The fluid may lubricate in a degree and reduce the friction of the cutting particles on the wheel, but it also has other functions. It entirely eliminates the grinding dust evil from the ordinary dry grinding operation, as the lubricant bears this dust away as soon as made. Lubrication keeps the temperature of the work being ground uniform over the entire surface of the cylinder, and—of most importance—it carries away the heat generated by the wheel in cutting particles from the work being ground. It dissipates the heat and in this way reduces the power required to grind.

In the early days of the grinding industry all grinding was done dry, but that time is past. It was considered that the only possibility in grinding was a polishing operation with a dry wheel. This was the conception of the engineers of thirty years ago. But as time went on, a few drops of water per minute were allowed to trickle on the wheel. Improvement was noticed, and then a small stream was allowed to run on the wheel. More work was done and now we allow a large stream of lubricating compound to flow upon the work at the point where the wheel comes in contact with the work. The results in increasing the production of grinding machines have been astonishing.

Clear water was the first agent tried, and then because of the rusting effect soda water was used. Soda, in itself, is a lubricant, and improvement was noticed. Then soapy water was tried, and finally after investigations had been made by chemists, aided by the experience of grinding engineers, compounds were made that give much better results. In these compounds, there are certain amounts of oil, soda water, soap, etc. These all have their functions to perform and contribute to the general efficiency. Perhaps even better results might be accomplished if clear oil were used for the grinding lubricant.

But we still have grinding machines used dry that should be operated as wet grinding machines. There is no reason for factories to continue to grind and snag castings dry when they should be snagged under a lubricant. Results would be greater economy and increased production. The same holds true of the tool-room and tool grinding. When work is ground dry, very light cuts must be taken in order that the heat generated will not seriously harm the work being ground. The heat generated in dry grinding causes a small section of the work to become heated, and as the revolution of the work is slow, the heat accumulates and causes warping due to expansion and contraction. It is impossible under a heavy cut to grind round and perfect cylinders. The same holds true if too little lubricating compound is used on the work. Enough must be used to dissipate the heat generated, reduce the friction and thereby keep the work at a uniform temperature throughout.

* * *

FIREPROOF STORAGE RACKS

A system of sectional fireproof storage racks used by the Ferracute Machine Co., Bridgeton, N. J., was described in *Industrial Engineering*. These racks are used for storing the finished parts of machines. They consist of a series of steel plates, mounted one above the other and held apart and supported by pieces of pipe of the required length. A steel rod or bolt, the length of which must be adapted to the number of shelves placed in the racks, extends from the end of the pipe section resting on the floor to the top of the highest shelf, where it is fastened by means of a nut and washer. Holes are drilled through the plates for these bolts. At the end of the bottom section of the pipe, where it rests on the floor, base washers are provided.

OXY-ACETYLENE WELDING OF ALUMINUM*

DIRECTIONS FOR CARRYING OUT THE WORK AND EXAMPLES FROM PRACTICE

BY S. W. MILLER†

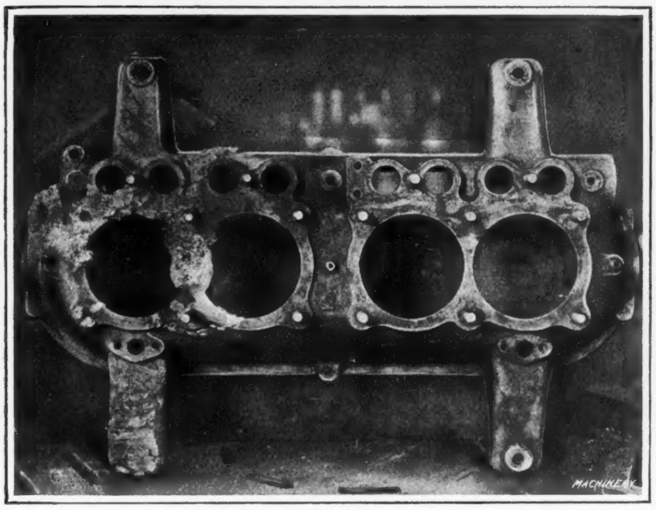

Fig. 1. Crank-case damaged by the Use of Flux and Improper Welding

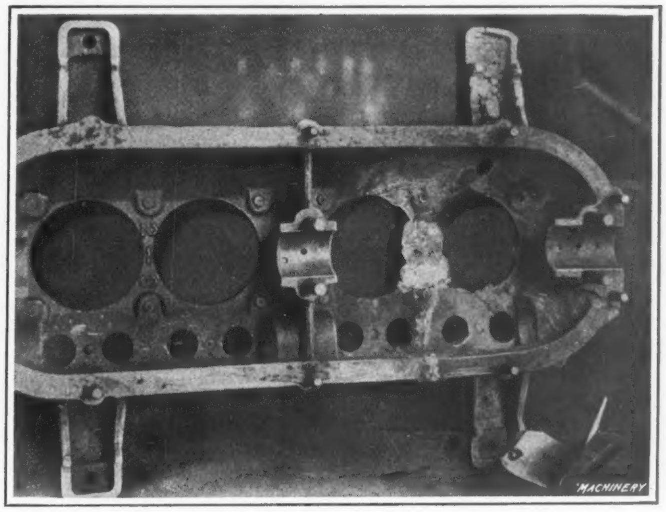

Fig. 2. Bottom View of Crank-case shown in Fig. 1

ALUMINUM is seldom used in its pure condition, as it is too soft, and in repair work only the aluminum alloys—principally in the form of crank-cases, transmission cases, and other automobile parts—are encountered. In the United States the usual alloy contains, at the present time, about 93 per cent aluminum and 7 per cent copper. In the past quite a number of parts were made from a zinc alloy containing approximately 90 per cent aluminum and 10 per cent zinc, but in foundry practice it was found that the alloy became brittle at a temperature just below solidification, so that many castings were defective on account of cracks due to shrinkage and had to be thrown out. The copper alloy, while not quite so strong at ordinary temperatures, does not have the tendency to crack that the zinc alloy has; this is fortunate for the welder, as cracking is likely to occur in many cases, particularly in a complicated piece, due to the contraction strains.

A zinc alloy is generally identified by the condensation of the white zinc oxide on the cooler part of the casting during welding, and it may be necessary to cut or break the casting at some place where it can be repaired without bad contraction strains, in order that the weld in the original break may be made. It is not very often that the zinc alloy is encountered at the present time, although when it is, it may cause the welder a great deal of trouble, and in some cases, it may be impossible to do the job. It is necessary with such zinc alloys to preheat the whole piece to as high a temperature as is safe, and handle it very carefully. Sometimes it is advisable to have an extra man to help in handling the work, as if the piece is dropped or jarred it may be damaged considerably. When the weld is rather long, it is sometimes necessary to use two welders, beginning at the center and working toward both ends, so that the variation in temperature and the resulting strains are not so great as they would be if only one torch were used. In the case of a copper alloy, this brittleness does not exist to so great an extent, and it is not necessary to take such great precautions, but in all cases where the defect extends into the body of the casting, it is advisable to thoroughly preheat and handle it carefully. Aluminum oxidizes readily, particularly at high temperatures, and as the oxide melts at a much higher temperature than the metal, and is heavier than the melted metal, it is likely to become mixed into the melted mass and produce a poor weld.

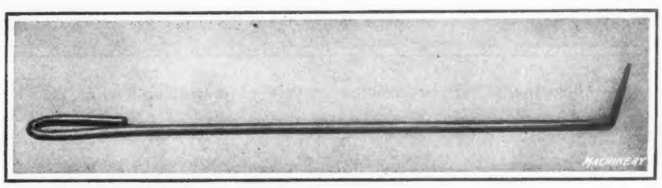

Fig. 3. Puddling Rod used when welding Aluminum

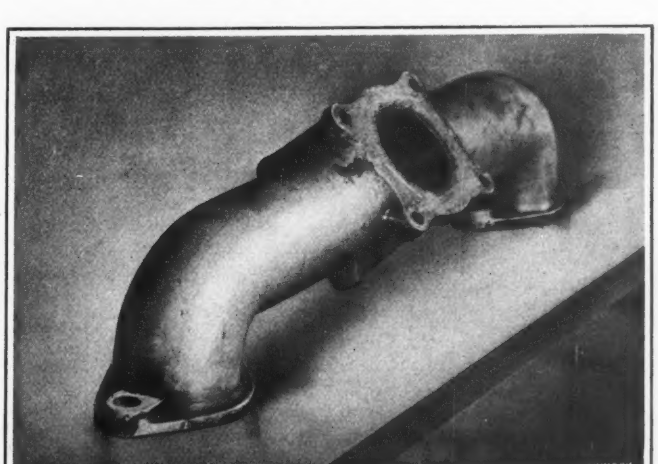

Fig. 4. Aluminum Manifold with Broken Lug

Flux for Aluminum Welding

It is frequently stated that it is impossible to make a sound weld in aluminum without a flux which will destroy the oxide. Aluminum oxide is exceedingly resistant to the action of any acid or alkali even at a high temperature. Therefore, the flux used in welding must be very severe in its action. The danger in using some kinds of flux is that an excess, unless it is removed in some way, will damage both the metal in the weld and that surrounding it. The writer has seen this action occur a number of times. It is true that the welding was done by those who were not very skillful, and who did not realize the importance of using the minimum amount of flux and brushing off the surplus in boiling water afterward. Another objection to the use of flux is that the surfaces to be joined must be thoroughly cleaned, because the flux is designed to remove oxide of aluminum and not grease and dirt, which are always present in repair work. The time occupied in cleaning the dirt out of the crack or break is considerable, and in most cases the

* For further information on oxy-acetylene welding, see "Oxy-acetylene Welding Practice," January, 1916, and articles there referred to. For welding aluminum, see "Methods of Jointing Aluminum," February, 1915, and articles there referred to.

† Address: Rochester Welding Works, Rochester, N. Y.

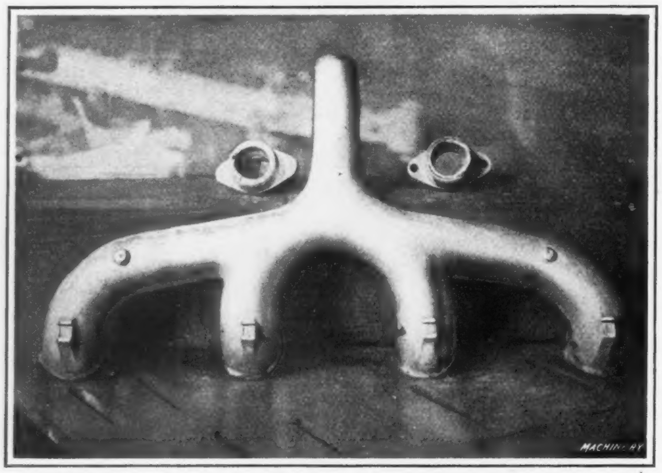

Fig. 5. Aluminum Inlet Manifold with Broken Carbureter Flange

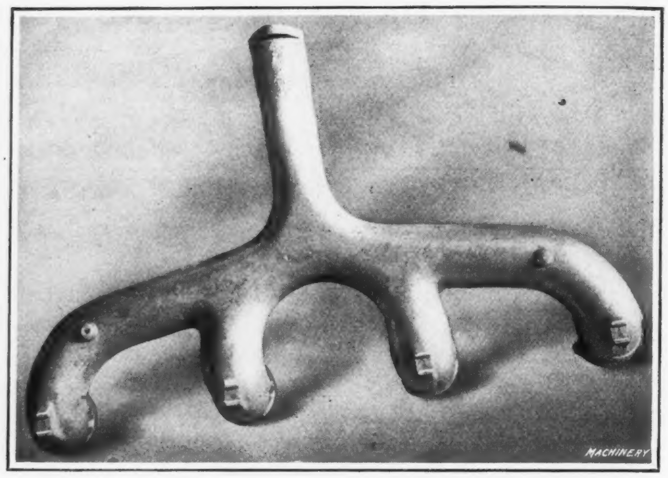

Fig. 6. Aluminum Inlet Manifold—Repairs Completed

weld can be made without flux in the time required to clean the piece thoroughly. Again, it is not possible, even by the use of a flux, to avoid some porosity in a weld; and further, in the best aluminum castings there may be, and frequently is, greater porosity than in a well puddled weld. In view of these facts, the author doubts the advisability or necessity of using flux.

The method used in the writer's shops in the case of cast aluminum is to thoroughly puddle it without any preparation, except wiping off the dirt and grease. There is an additional advantage in not making a V at the break in the case of aluminum, which is that the sections are generally thin and the contraction of the weld is better resisted by the piece being allowed to remain its full thickness, although of course the contraction is not entirely avoided.

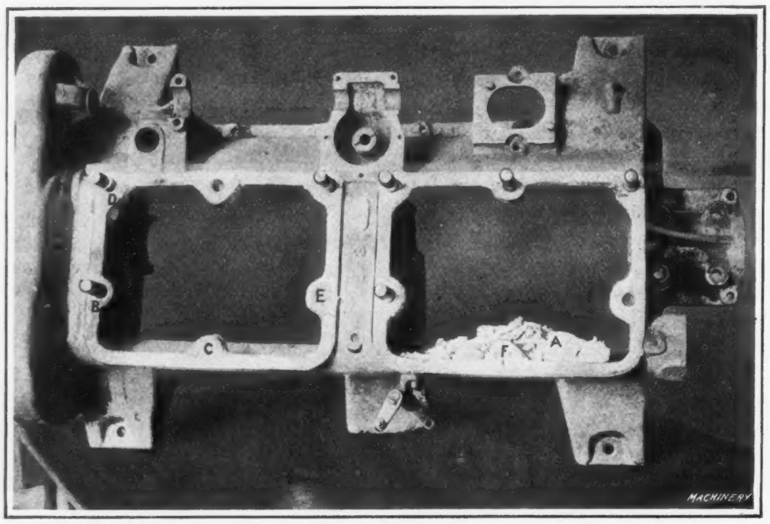

Fig. 7. Aluminum Crank-case showing Method of preventing Cracks in Welding

Figs. 1 and 2 show the damage that can be done by improper treatment. While the writer is not sure of the original condition, this type of case generally is not seriously damaged when a connecting-rod or bolt gives way, which apparently was the cause of the damage. However this may be, the fact remains that whoever welded it (it was not done in the author's shops, but sent there to be properly repaired) used altogether too much flux on it, and was unable to get satisfactory results. The case was so seriously damaged by this treatment that the cost of putting it in proper shape would be much greater than if it had been properly repaired in the first place, and would be so high that it would probably be inadvisable to spend the money on it. This is a good illustration of the incidental damage that can be done by improper welding. Undoubtedly, the welder who attempted to do this job had had little, if any, experience, was using a cheap outfit, and had no instructions in the principles of the art. This is not the only piece that the writer has seen damaged in the same way, and illustrations could be multiplied without end of cases where such serious damage was caused by improper welding as to require the purchase of new parts.

Procedure in Welding

A puddling rod such as shown in Fig. 3 has been found most satisfactory, although other shapes are used. In all ordinary cases, the metal should be melted with the torch until the bottom of the crack is reached, using the puddling rod all the time, and the metal should be allowed to sink below the lower surface of the crack, forming beads. These beads can be removed afterward, either by the torch and puddling rod, or by chipping or filing. In welding thick pieces, the work must be done from both sides. In this case too much of the welding should not be made on one side at once. It is better to weld, say 2 inches, on the first side, and then turn the work over and finish welding the 2 inches on the other side, then proceed along 2 inches further, and again turn the piece over and weld 2 inches more on the first side. The reason for this is that aluminum is somewhat brittle near the welding temperature, and cracks are likely to develop, particularly in a long weld, if all the weld is made on one side first, and then finished on the other. On account of this brittleness, a weld in aluminum must be made quickly.

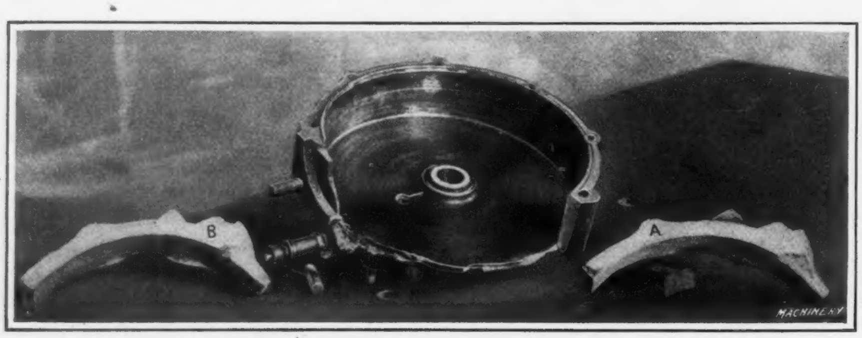

Fig. 8. Aluminum Crank-case, Defective Part used for Pattern and New Part cast from Pattern

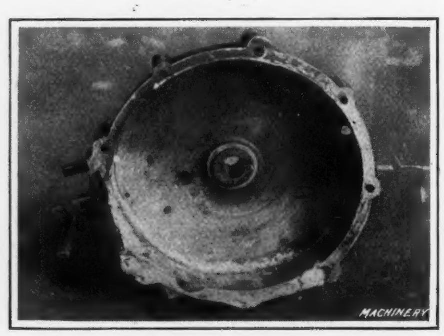

Fig. 9. Same Crank-case as shown in Fig. 8—Finished Weld on Inside

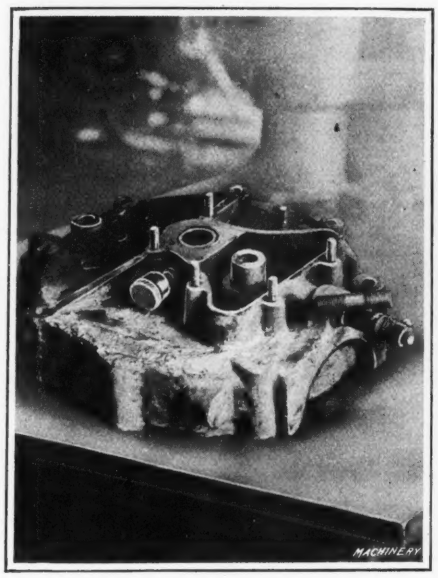

Fig. 10. Same Crank-case as shown in Fig. 8—Finished Weld on Outside

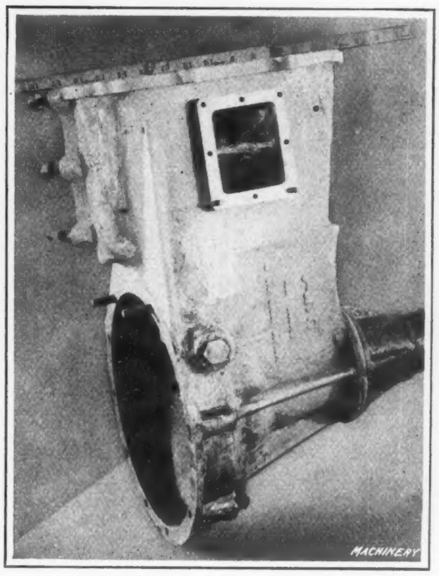

Fig. 11. Example of Badly Damaged Aluminum Casting which has been welded

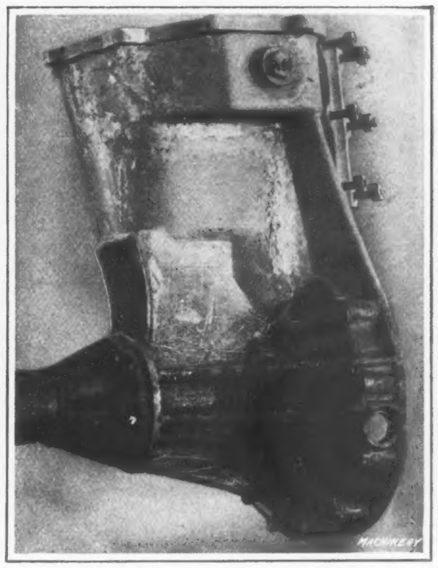

Fig. 12. Opposite Side of Aluminum Casting shown in Fig. 11

Slow work is fatal to good results. It is occasionally necessary in a long weld to have two welders start at the middle of the crack, and work toward the ends, to avoid shrinkage cracks.

On account of the tendency of aluminum to oxidize, it is advisable to use a flame with a slight excess of acetylene. Too much metal should not be added from the welding rod at one time, and what is added should be thoroughly puddled with the welding rod while it is being added and afterward, until there is a melted pool at that point and the proper union has been made with the surrounding metal. The surplus metal should be scraped off with the puddling rod while in a pasty condition, as it contains much oxide, and the welder should be sure to make a good junction at the edges of the weld.

The manipulation of the torch with one hand and the welding stick with the other, the latter having to be laid down and the puddling rod picked up at frequent intervals, is rather difficult. Some welders find it easier to hold the torch in the left hand, although ordinarily right-handed. This is the case with the writer; others find the opposite way to be the easier. In either case, the trouble is caused by the difficulty of working with both hands at once.

When adding the metal from the welding stick, it should be continually rubbed into the melted pool in order to avoid oxidation and to work the oxide to the surface. A beginner should weld and break quite a number of test pieces before he attacks any important job. He should not be discouraged at the result of his first attempts, which are certain to be unsatisfactory, much more so than with any other metal, although aluminum is the easiest metal to weld, after the difficulties in handling it have been overcome.

Examples of Aluminum Welding

Fig. 4 shows the best method of replacing a broken lug on an aluminum manifold. It should be laid on the table as shown, and a small weight put against the lug to keep it from moving. No larger tip should be used than is absolutely necessary, in order to avoid melting the lug, this being likely to occur if care is not taken. The cold table will tend to overcome part of this trouble, as it conducts an excess of heat away. After the back of the lug is welded (and the weld should be made almost entirely through from this side), the inside should be finished, being sure to remove all the crack.

It is not possible in the case of lugs on aluminum manifolds to use the block and clamps used in the case of cast iron, as aluminum would crush under the clamping strain. Immediately after welding, the lug should be tested with a straight-edge to be sure that it is true with the rest of the face. If not, it can either be bent down, or a little metal added where it is low.

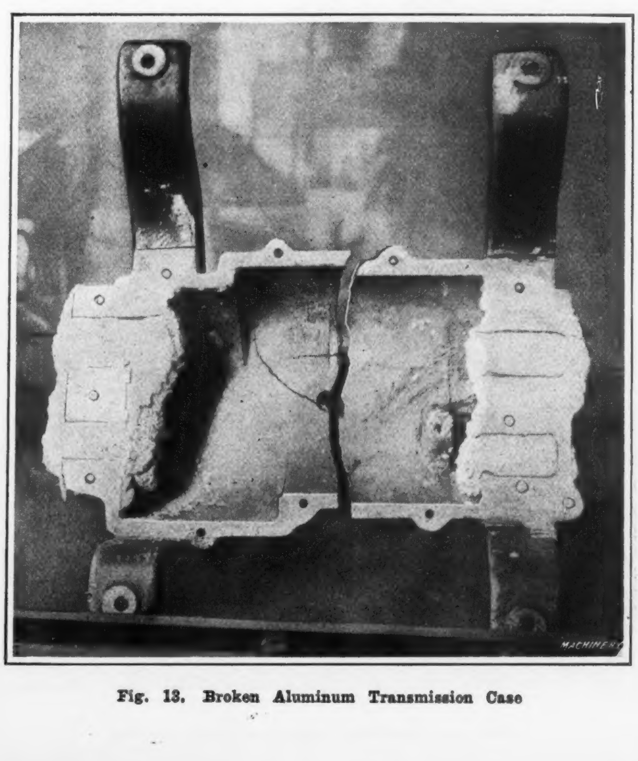

Fig. 13. Broken Aluminum Transmission Case

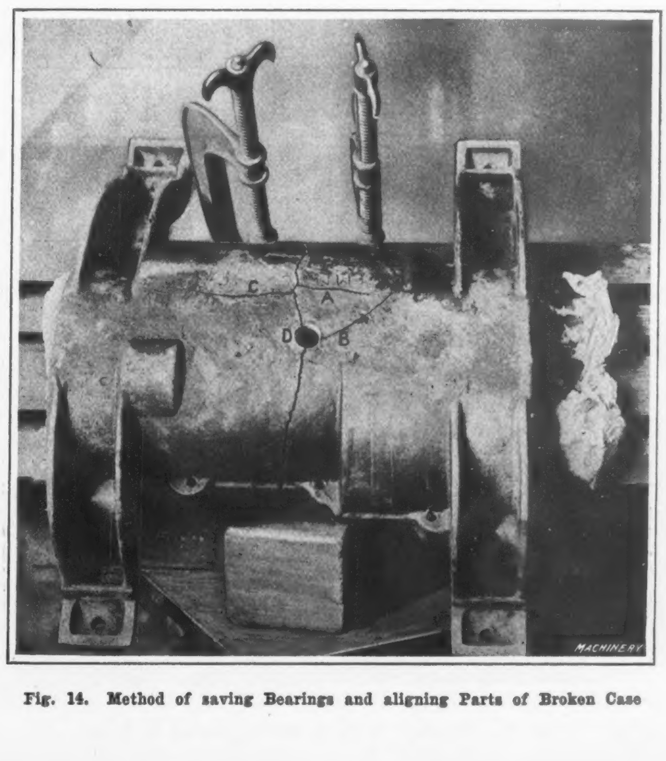

Fig. 14. Method of saving Bearings and aligning Parts of Broken Case

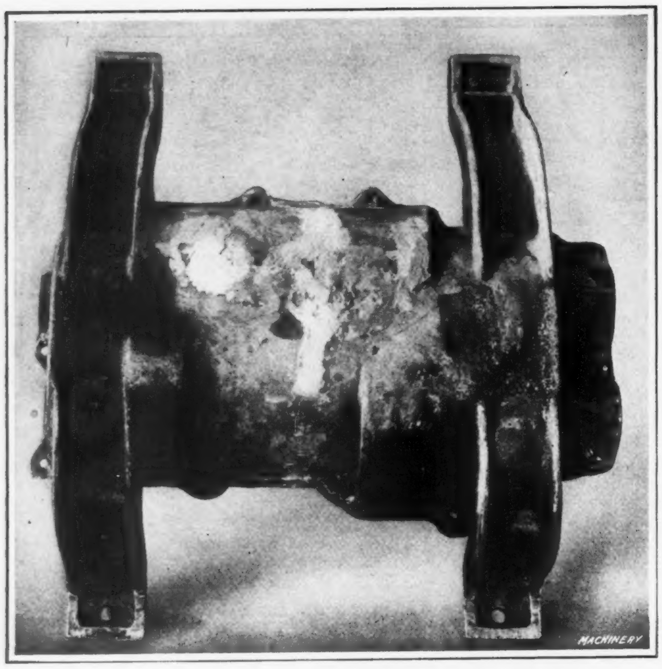

Fig. 15. Outside View of Completed Repair Job

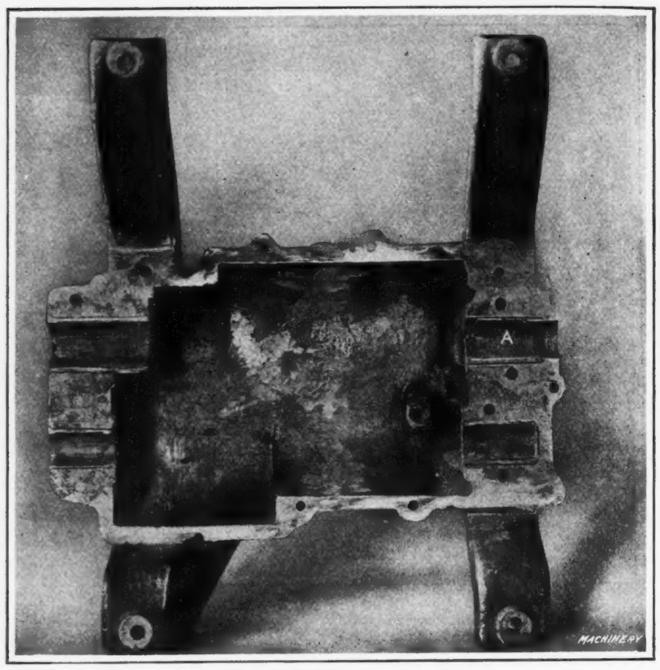

Fig. 16. Inside View of Welded Case

In the majority of cases, and especially in the case of small lugs, it does not pay to put back the old lug, and it is good practice to build up a new one. An expert welder can build up a lug without any assistance from forms, etc., but the beginner had better make a mold out of a thin piece of sheet metal, of the height and shape of the lug, and hold it in place with a small weight, filling up the mold. The body of the manifold should be raised about 1/32 inch from the table with a piece of a hack-saw blade, or something similar, to allow stock for finishing. It is necessary in this case to be particularly careful to get a good union between the new metal and the old.

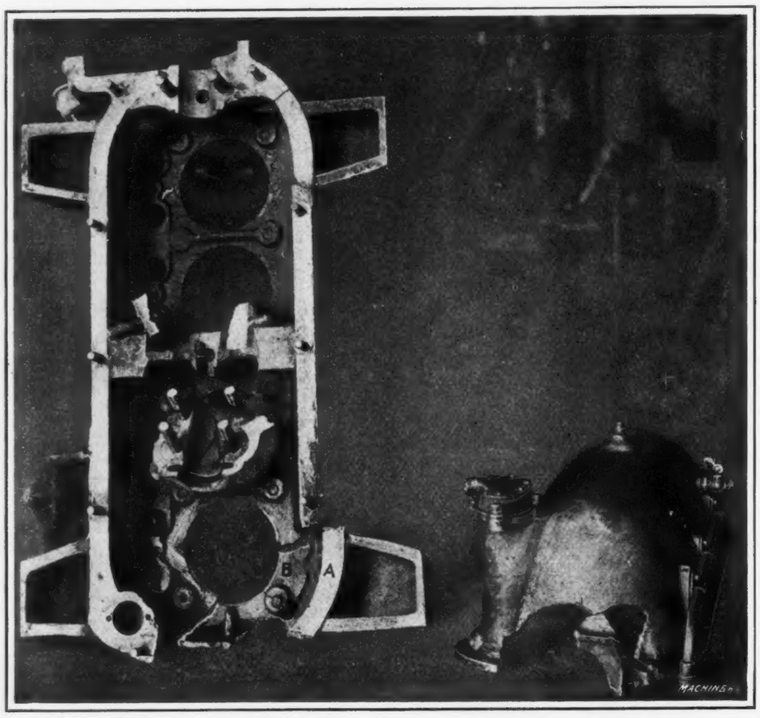

Fig. 17. Upper and Lower Halves of Crank-case as received for Repairs

Figs. 5 and 6 show the best method for repairing an inlet manifold. The original manifold was cast in one piece of aluminum. Later it was desired to change the carbureter, and as the new carbureter flange would not fit the manifold, a new flange was made of brass and screwed on. The threads on the manifold can be seen distinctly. The repair was made by casting a flange of aluminum, using the old brass flange as a pattern by filling up in places to permit its being drawn from the sand, and welding it on. The finished job is shown in Fig. 6.

Fig. 7 shows a type of crank-case that fre-

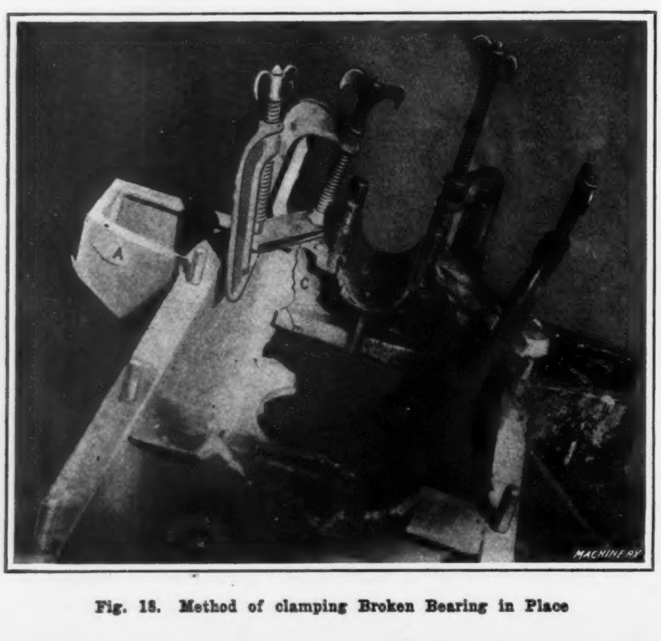

Fig. 18. Method of clamping Broken Bearing in Place

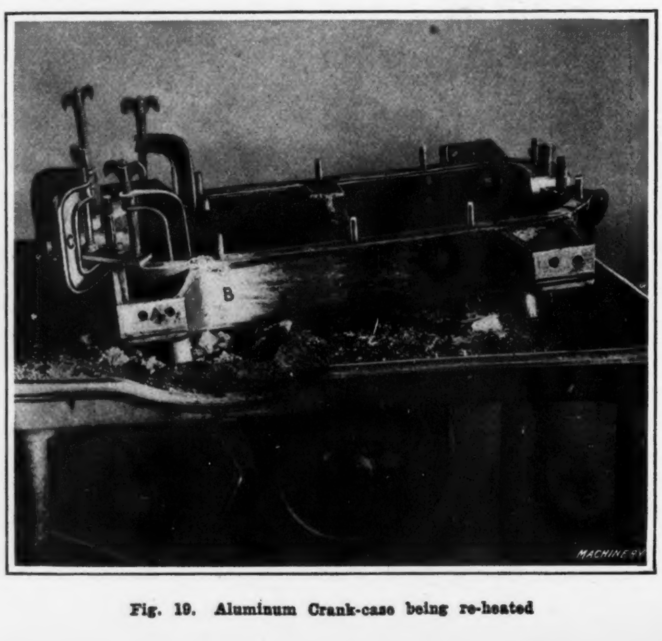

Fig. 19. Aluminum Crank-case being re-heated

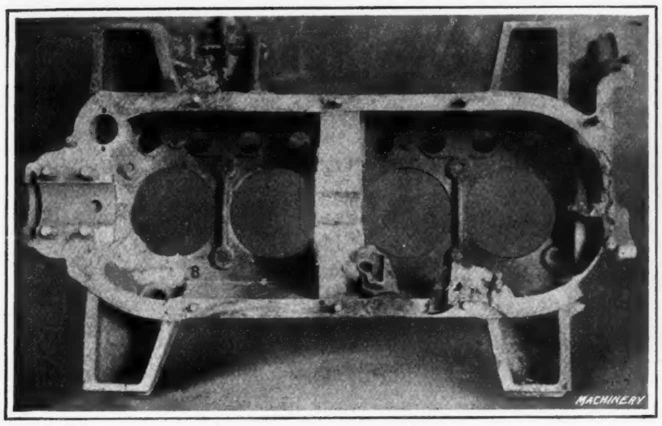

Fig. 20. End Bearing finished, Center Bearing built up, and Front Bolting Lug welded

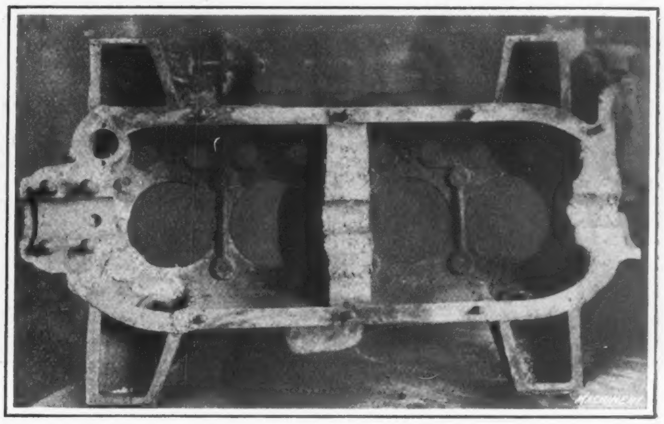

Fig. 21. Upper Half of Crank-case as shown in Fig. 20, with welding completed

quently gives trouble from the lugs breaking off. Here three of the lugs were broken when the case was received, and the shop was instructed to reinforce the others. The missing lugs were *C*, *E*, and *F*. These were built up solid. All the others were reinforced with the exception of *B*. This was not done because of the desirability, found by experience, of avoiding cracking through the end of the case which happens generally, although not always, and inasmuch as all of the other lugs for both pairs of cylinders were heavy, it was thought unnecessary to reinforce lug *B*. No precaution with which the writer is acquainted will invariably stop the cracking at this lug. However, in the majority of cases, the welding of the lugs at *C*, *F*, etc., can be done without cracking the sides, provided loose wet asbestos, as shown at *A*, be packed so as to cover the side, and be allowed to become dry while the case is preheating. This keeps the heat of the welding flame from striking the side of the case and overheating it. It should also be stated that in the majority of cases of this kind the material appears to be a zinc alloy, which is very likely to crack even with the best treatment. The foregoing method of overcoming the difficulty can be frequently applied to other cases.

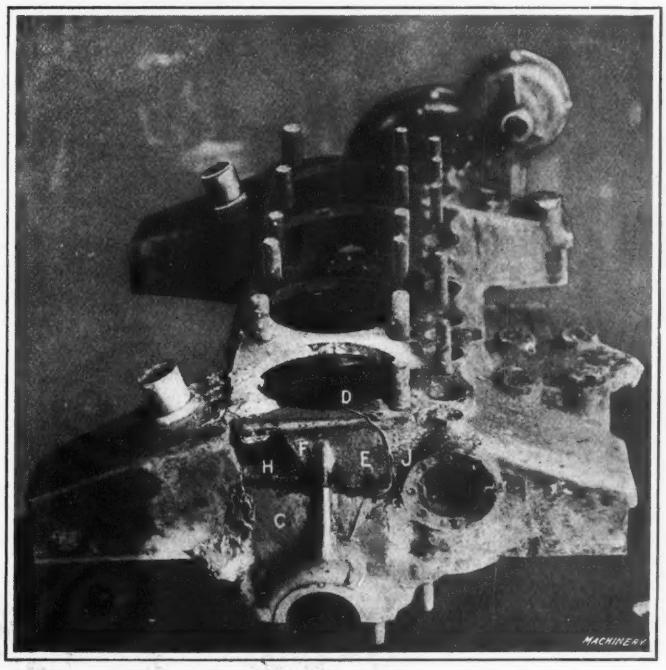

Fig. 22. End Bearing partly welded in and Pieces set ready for Welding

Figs. 8, 9, and 10 show an aluminum crank-case of an old-style automobile motor, which is located on the rear axle of the car. The part removed had been at some time soldered in, and while this job was all right for a while, it eventually began to leak. Another crack also appeared which made it necessary to repair it in some way. As it would have been impossible to do any welding in the presence of the solder, the entire defective piece was cut out and used as a pattern, this being shown at *A*, Fig. 8. Enough plaster-of-paris was added on the inside and face of the piece to allow for finishing. The casting made from the pattern is shown at *B*, and the finished work in Figs. 9 and 10. This job illustrates the possibility of using the pieces removed as patterns, instead of making new plaster-of-paris patterns. Even when the parts removed are quite badly broken, they can sometimes be fastened together with plaster-of-paris much more easily than a new pattern could be made. This is particularly true where there are lugs or other projections which are difficult to reproduce in plaster-of-paris. A little ingenuity will frequently reduce the time on a job of this kind considerably.

Figs. 11 and 12 illustrate what can be done with a badly damaged aluminum casting. The process through which it was put is no different from that which has been explained before, and is of interest principally on account of the fact

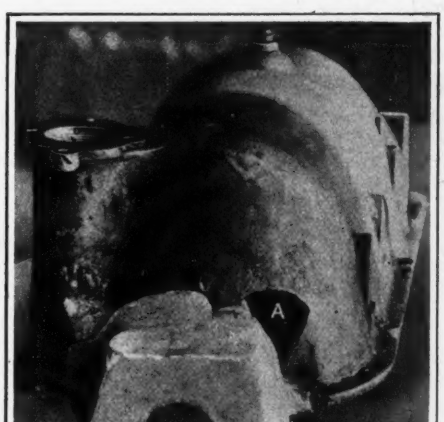

Fig. 23. Lower Half of Crank-case to be repaired

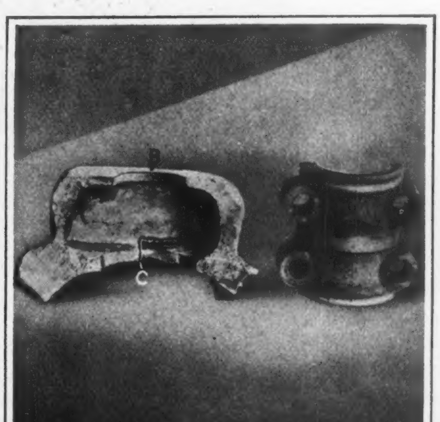

Fig. 24. Plaster-of-paris Pattern for Missing Part and Rear-end Bearing Cap

Fig. 25. Lower Half of Crank-case shown in Fig. 23, as repaired

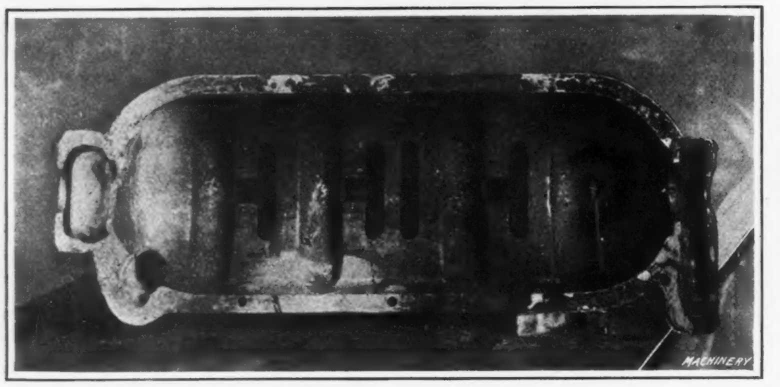

Fig. 26. Inside View of Repaired Lower Half of Crank-case

that there was over six feet of cracks in the piece. In this particular case the pre-heating was done with two Bunsen burners which were kept lit while the piece was being welded. The Bunsen burners were used on account of the difficulty of handling the piece in the fire. While it is generally unnecessary to use a helper to handle a piece of this size, in this case, on account of the location of the breaks and the large number of times the work had to be turned over, time was saved by using a helper.

Figs. 13 to 16 show a badly broken aluminum transmission case of an old design with babbitt bearings. It is quite difficult to re-babbitt such bearings so as to preserve the center distances between the shafts, unless a jig is available; hence it was decided to save them. It so happened that the width of the face of the crankshaft jig was just right to permit of the face of the transmission case being laid on it and clamped in position as shown in Fig. 14. This does not show, however, all the clamps that were applied. The two clamps shown are simply to hold the pieces in place while the photograph was taken. The first operation was to weld the cracks *A*, *B*, and *C*, while the two halves were separated. The case was then lined up, and in order to prevent uneven contraction, two welders did the work, beginning at the hole *D* in the center. When the first man had welded about 2 inches on his side, the other man started in, and they finished the case together. The result was complete alignment and a very satisfactory job. The finished work is shown in Figs. 15 and 16, after it had been rough-ground. In order to save the bearings, they were filled with plaster-of-paris as shown in Fig. 13. This was allowed to dry thoroughly, and was then warmed over a gentle charcoal fire to drive out the moisture. The plaster-of-paris was scraped off level with the face of the aluminum in order that the cold base of the crankshaft jig might come into as close contact as possible with the babbitt and thus keep it cool while welding. Pre-heating was done with two Bunsen burners, one on each side. All the babbitt was saved, except the small corner in one bearing as shown in Fig. 16, at *A*. The alignment of the bearings and face was perfect.

Figs. 17 to 26 show that no matter how bad the damage may appear, it is possible to repair a crank-case, provided a little ingenuity and forethought be used. One of the frame lugs is entirely broken off and another cracked on both sides, and all three bearings are broken out; in addition, most of the end of the bottom half is missing. This damage was caused by allowing the center bearing to become loose, which caused the crankshaft to break and resulted in the damage shown. An examination of the crank-case made it evident that it would be very difficult, and certainly inadvisable, to replace the pieces of the center and front-end bearings. At the time Fig. 17 was photographed, it was not noticed that the top-end bearing was as badly broken as shown in Fig. 20, although it was known to be cracked. The first operation was to warm the crank-case in a rather small charcoal fire, as shown in Fig. 19, and weld the frame lug *A*, Figs. 17, 18, and 19, in place, taking care to put it in line as closely as possible. This weld is shown at *B*, Figs. 19 and 20. The next operation was to set the rear-end bearing *C*, Figs. 18, 19, and 22, in place, clamping it as shown in Figs. 18 and 19. Planed blocks were used to hold it true, the surfaces of the body of the crank-case on which these blocks rest having been previously tested with a straightedge to make sure that they were true. It is generally desirable in the case of a crack in the side or end of a crank-case to do all the welding except one crack, and then begin with one end of that crack, as for instance at *D*, Fig. 22, and end up at the other end.

In this case this is not advisable, because the important point is to have the rear-end bearing accurately in position, and this can be done better by setting the fractures together, than would have been possible if any shrinkage had taken place from the prior welding-in of piece *E* and filling up at *F*, Fig. 22, which latter part was missing. It is evident that it would have been difficult to make the bearing straight and true under these conditions.

In Fig. 22, when welding in the end bearing, the two side welds were not finished quite up to the ends of the breaks at *H* and *J*. This was to permit of an easier fitting of the piece *E*, and is a practice that should also be followed where several pieces have to be put in separately. It might be stated that the end bearing fitted in place very nicely as may be seen from Fig. 18. Piece *E* was then welded and hole *F* filled up, as was also a stud hole in boss *B*, Fig. 17. It is not advisable generally to attempt to preserve the thread in a hole through which a crack runs. The job is much more solid if it is filled up.

The next operation was the welding of the center bearing, which, as explained above, was built up new. Then the other frame lug was welded as shown in Fig. 20, and finally the front-end bearing was built up, the finished job being shown in Fig. 21.

Some thought and knowledge of the shape of the rear end of the bottom half of the crank-case were needed in order to make the pattern shown in Fig. 23. It so happened that the welders were familiar with what had to be done, or it would have been necessary to examine a similar part in good condition. The bearing cap was put in place on the upper half of the crank-case and used as a guide in the preparation

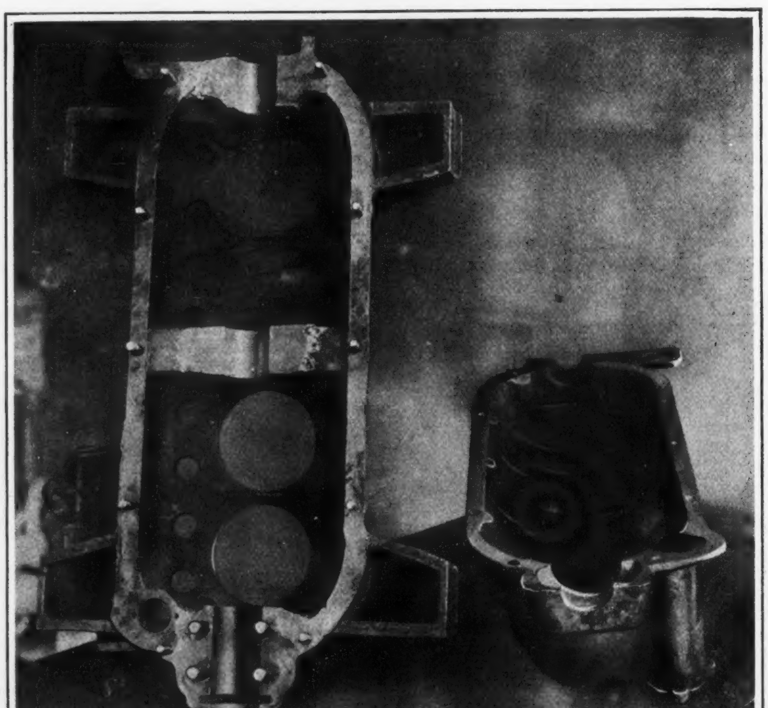

Fig. 27. Both Halves of Crank-case Machined and ready for Assembling

of the pattern. It was necessary to remove that part of the pattern which occupied the space *A*, Fig. 23, as, if it had been left, it could not have been drawn out of the sand. Stock was allowed for finishing at *D*, Fig. 23, and *B* and *C*, Fig. 24.

Figs. 25 and 26 show the lower half of the crank-case welded, while Fig. 27 shows both halves of the crank-case machined and ready for service, except for the drilling and tapping of the holes for the center and front-end bearing cap studs. This could not be done, as the caps were not at hand.

No special precautions had to be observed in welding this case, the main considerations being the measuring of the diameters of the bearings before doing the work, as no two of them are the same size; keeping the crank-case quite warm while doing the work; and doing it as quickly as possible, which is a necessity in all aluminum welding. Of course, the machining of such a job requires considerable care and is best done, as far as the bearings are concerned, in a horizontal boring machine. If this tool is not at hand, as generally it is not, it can be done in a lathe by clamping the case on the carriage and using a boring-bar between the centers. The job can be done in one-half the time or less on a horizontal boring machine, as it can be set up with greater ease and accuracy. Of course, the cylinder face of the upper half was milled off at the weld, but it was not found necessary to bore the rear-end bearing, nor to mill off any of the faces of the crank-case, except where stock had been allowed for the purpose, or where the welds had been made; so that it is perfectly possible, by taking due care, to avoid much of the machine work that is frequently done.

This example of welding is given in considerable detail, because it covers a great number of instances which do not have all of the different kinds of damage sustained by this one. It was not a particularly difficult job, although considerable time was consumed in doing it. The comparative simplicity is largely accounted for by the fact that there was no trouble from contraction, the damage being so great that the strains were easily taken care of.

It might be well to mention here the necessity of obtaining good castings for such repair work. It will not do to use the material frequently furnished by small foundries, which they claim to be aluminum. The writer uses nothing but No. 12 metal, which can be purchased from aluminum manufacturers in pigs. No scrap whatever is permitted, nor any other alloy. In case of serious difficulty in obtaining castings of the proper quality, or if it should be necessary to send a long distance for them, it is recommended that a small crucible be obtained and pig metal melted in it in a small furnace designed for the purpose. This furnace can be connected with any flue ordinarily used in a stove. It is not satisfactory to melt this metal in an iron ladle, as it is too much exposed to the action of the air. As soon as the metal is melted, it should be covered with a layer of fine charcoal to prevent oxidation as much as possible. A small flask made of wood and some fine molding sand are easily obtained, and will be found very convenient for many purposes.

Care should be taken in melting aluminum not to get it too hot, and it should be well skimmed while pouring to prevent the oxide from passing into the mold. The shrinkage of aluminum is considerable, about 7/32 inch per foot, and the pattern should be well rapped in order to allow for this, or else the necessary stock should be added to the pattern to take care of it. A novice will probably have some trouble at the start, but a little care, and if possible, the observation of the various processes at some foundry, will help a great deal. Of course, a greater amount of pig metal should be melted than is needed for the casting, and any surplus should be poured into a mold or into a hollow made in the sand pile. It should not be left in the crucible.

* * *

Invar metal, which is an alloy of nickel and steel having a very low coefficient of expansion—about one-twenty-fifth that of steel within the ordinary limits of temperature—has not hitherto been manufactured commercially in the United States. Invar tapes used for base measurements in surveying have been obtained from England, but now the alloy is obtainable from the Midvale Steel Co., Nicetown, Philadelphia.

WHO OWNS THE PATENT RIGHTS?*

There seems to be a misconception among working men and business men in general, of the respective legal rights of employer and employe to inventions originated by the employe. These rights, while not defined by federal status, have been definitely established by a long series of judicial decisions which constitute a part of what is technically termed "The Fixed Law of Patents." These decisions, although rendered at widely varying times and by courts scattered throughout the country, agree in recognizing the rights of the employe as well as those of his employer. But, instead of according the entire rights to one or the other, they apportion these rights in a manner which would seem to be both reasonable and equitable.

Briefly stated, the general ruling is this: Where an employe makes an invention in the course of his occupation, the fact that the employer paid for his time and that the invention was developed with the aid of tools and materials furnished by the employer gives the latter a definite, although limited interest in the invention. This interest is commonly called a "shop right," being the employer's unrestricted right to manufacture, use and sell this invention in and from the particular shop or factory in which the invention was made. However, the employer cannot claim any exclusive rights; he has no right to license others to manufacture the invention, nor can he control its duplication by other parties. All rights outside of the factory in which the invention was made belong to the employe. The patent must be taken out in the name of the latter, if it is to be valid, and this patent then is automatically subject to the above-described "shop right," although otherwise controlling the field. If the employer wants the entire market control of the invention, he must acquire the balance of the patent rights from the inventor either by buying the patent outright or by securing an exclusive license under the same.

In other words, the law says that in return for the facilities afforded by the employer and the money paid for the inventor's time while making the invention, the employer shall have a license under the inventor's patent rights, but this license shall not be exclusive. Nor can the employer sell this license (*i. e.*, his "shop right") to some other concern; if he ceases doing business, it becomes void. Thus, each party is recognized as having a distinct share of the rights to the invention and the employer can only lawfully obtain the entire control of the patent right by acquiring the same from his employe. The latter, through ignorance of the law or through a misunderstanding of the same, may part with his share for a mere pittance. That has often occurred in the past and probably will recur in the future so long as but few men are aware of their rights, but it shows no defect in the laws. The real shortcoming lies in the carelessness or indifference of the employes, most of whom make no effort whatever to ascertain their real rights.

Moreover, the above-mentioned division of rights holds only where the invention was made on the employer's time, or with the employer's tools and materials, or by the use of both. It does not apply to inventions which the employe may make after working hours and which he makes and perfects at his own expense, unless the employe has signed a contract to the contrary. In case of such a contract, an adequate compensation or "consideration" must be shown for the rights to such inventions and, generally speaking, these must be in the lines for which the employe is hired. In other words, the fact that an employe is hired and paid for a certain occupation does not give his employer a blanket mortgage on the employe's brains, although no one can prevent the employe from giving away his rights if he chooses to do so. Indeed, loyalty to his employer may demand a liberal attitude on the part of the employe in such matters; but in order to be even reasonably liberal the employe must first learn just what rights he actually has. Unfortunately, too few men are in earnest when it comes to ascertaining their exact rights and undoubtedly many suffer as the result, but the law should not be blamed for this.

* Albert Scheible in the "Iron Tradesman."

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FEBRUARY, 1916

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LOOKING AHEAD

The placing of war orders for machine tools culminated in December and a gradual decline is in effect; not necessarily because the Allies have sufficient equipment ordered, but because they are not now in such urgent need that they are forced to place orders here at the present high prices, with deliveries from six to twelve months. A gradual decline in war orders, such as now appears to be taking place, instead of a sudden drop, especially as it is being followed by increasing home demand, is as near an ideal condition as any manufacturer can ask. With a reduction in the price of machine tools from the present high levels, and with reasonable deliveries, the home demand should continue to increase. Such a change will be welcomed by domestic dealers and users, who have been almost at a standstill on what is called "normal" business; for while machine tool builders are still booking orders on six to twelve months' delivery, the conditions are unsatisfactory both to them and to their customers.

The prosperity of the machine tool industry is of course dependent on the prosperity of manufacturers generally; and the true test of the future is to be found in general conditions rather than in special ones dependent on war orders. If our industries generally are busy it goes without saying that prosperity is general—that even railroads will make money, and with the changed public sentiment in regard to them and the enormous amount of liquid capital, it will be easy to finance their requirements for new equipment, which as every one knows is badly needed. Active railroad buying alone will exert an even more powerful influence on the general situation than the automobile industry has done and is now doing. But railroads will hardly begin buying actively at prevailing prices.

A careful and extended inquiry among representative firms covering the entire country indicates a general industrial revival—slow in some sections, active in others. Industries dependent upon material made in Germany are the exceptions. Manufacturers who sell to enterprises of widely varied character, in no way connected with war business, report a steady and increasing demand for their products. They say that many plants not turning out war material have a large amount of business booked which they are unable to go on with because they cannot get the raw material, and this applies to domestic as well as imported supplies. They also say that the activity due to war business will slowly decrease, that domestic business is waiting to take its place, and that as this process goes on "the habit of prosperity will become established and we will go on at a good pace."

Manufacturers generally are wisely resisting temptation to overbuild; the great extensions being put up by concerns who have obtained enormous war contracts have been figured on a basis that insures the manufacturers a return sufficient to include the cost of additional plant as well as a profit on the product. Those who are extending plants on any other basis are taking big risks, and this is particularly true of machine tool plants. The output of machine tools before the war was ample for all requirements, and will be no less when the war ends. Outsiders who are anxious to join the war game are advised to proceed with caution. Those already in are familiar with its drawbacks, the first of which is the scarcity and high price of material and the difficulty of getting satisfactory labor. Something like a famine now exists in certain domestic materials, and only a let-up in demand will remedy that.

Everyone expects a period of readjustment to follow the war; and the length of that period will depend upon the impetus our industries have attained before peace comes. As the continuance of our prosperity is dependent to a considerable extent on the duration of the war, the longer it does continue the better we should be prepared for its close. There is unfortunately no indication of peace before another winter, and in the interval it seems to us that the production of all kinds of war material in this country will gradually slacken, while our home demand will steadily increase, so that the speed of both these movements will more nearly approach normal. This readjustment period has already begun, and when peace comes and with it changed conditions, we should be in a great measure prepared for them.

* * *

CHANNELING MACHINES

The general use of inflammable building materials is one cause of the appalling annual fire waste of the United States. In the larger cities, measures have been taken to prevent the destruction of buildings by requiring them to be of slow-burning construction, or semi-fireproof. No building even though made of non-inflammable material can be regarded as fireproof if it contains large quantities of wooden furniture or inflammable goods. The intensity of heat generated in a conflagration is so great as to destroy concrete, steel and other non-inflammable building materials. But the use of these materials in buildings greatly reduces the fire risk.

The demand for steel window sashes, window frames and doors has developed a new industry in sheet metal working, that is, the forming of sheet metal into hollow sections of varied cross-sectional shapes by the so-called channeling machines. These machines are of the rolling mill type, ingeniously devised to laterally fold sheet metal stock into a great variety of moldings, ogees, fillets and other shapes by a continuous process. The metal is fed to the machine in long strips, and is shaped by the rolls, leaving the machine perfectly formed. The advantages of the channeling process are rapidity of manufacture, saving of material, simplicity of equipment and ease with which patterns can be changed.

While beading, folding or seaming of sheet metal by rolls was developed very early in the tinsmith's trade, the design of channeling rolls such as are required in the manufacture of architectural shapes is something with which comparatively few designers are familiar. The rolls are required to bend the material laterally and to draw it through the machine by their tractive effort. Variations in diameter must be compensated for in gearing ratios, and other expedients resorted to in order to accomplish the desired end with a minimum of friction.

The uses to which sheet metal shapes produced by the channeling process are put are many. Not only may shapes peculiar to architecture be cheaply made, but many other shapes useful in machine construction, furniture manufacture, concrete molding and other lines as well. Channeling may be regarded as a special development of press work in which bending rolls, working the piece progressively, take the place of reciprocating tools in the punch press.

THE EXPORTATION OF AMERICAN MACHINE TOOLS

BY GEORGE R. WOODS*

Europe is our best export market for machine tools, the volume of business jumping from $4,800,000 in 1910 to $12,260,000 in 1913. The grand total of our machine tool exports throughout the world in 1913 amounted to $16,100,000, this being 5.35 per cent of the total of our iron and steel exports. For the year 1915 (December estimated) our machine tool exports will total about $39,000,000, this being 13.33 per cent of our iron and steel exports in 1913 and equal to our total exports of agricultural implements for that year.

Our machine tool exports this year will also exceed our automobile exports in 1913 and come within $13,000,000 of equalling the exports of cotton manufacturers in 1913.

To show the relative importance of export fields, reference should be made to Table I showing the consumption of machine tools in 1913 by continents. This table also shows the volume of business done by Germany in the same period.

TABLE I. EXPORTS OF MACHINE TOOLS IN 1913 BY THE UNITED STATES AND GERMANY

	United States	Germany
Europe	$12,268,677	$17,992,539
North America	2,554,420	453,568
South America	571,919	842,457
Asia	202,620	364,903
Australia	460,825	54,978
Africa	37,031	......
	$16,095,492	$19,708,445

Before analyzing the European market, which is of most importance, brief comment should be made on the situation elsewhere. Before the war Germany led the United States in South America and in Asia, but notwithstanding the appeals made by industries in that territory during the war no special effort has been made by American manufacturers to intrench themselves in these German fields because of the enormous volume of our European business. Consequently, the conclusion of the war will not find the American machine tool industry in any better position in Asia or in South America. Inquiries from China, Japan and Argentina are being ignored today because no deliveries can be made; Europe takes practically all machine tools now exported. If American machine tool builders continue to make themselves dependent on Europe for their export business, it is expedient, to say the least, that a careful study be made of that field and reference is invited to Table II, which gives an analysis of the European market by countries. This table also shows the volume of business done by Germany during the same period.

TABLE II. EXPORTS OF METAL WORKING MACHINERY TO EUROPE DURING 1913

	From Germany	From United States
Austria-Hungary	$ 3,047,775	$ 600,593
Belgium	1,798,104	786,679
Bulgaria	23,177	13
Denmark	288,634	84,753
Finland	66,420	24,947
France	3,208,936	1,936,908
Germany	......	3,175,188
Greece	......	2,310
Italy	1,545,043	437,910
Netherlands	981,249	260,893
Norway	192,962	79,366
Portugal	61,715	1,391
Roumania	143,374	110
Russia in Europe	3,524,251	1,088,751
Spain	405,687	109,624
Sweden	462,731	241,373
Switzerland	698,274	17,108
Turkey in Europe	37,460	3,105
United Kingdom	1,486,582	3,417,655
	$17,972,374	$12,268,677

Among the many questions that assert themselves upon studying this table, we give for instance:

Assuming that the Central Powers are prejudiced against American machine tools, will Germany be able to supply the $3,700,000 worth of machine tools which she and Austria purchased in America in 1913?

Assuming that Germany attempts to regain her position in Russia, will she find the United States prepared to diminish the annual business of $3,500,000 which Germany did there before the war?

Will the United States be prepared to get any part of Germany's share of Belgium's machine tool business which, in 1913, amounted to $1,800,000?

Assuming that the Central Powers, which purchased $3,700,000 worth of American machine tools in 1913 are not prejudiced against the United States, will we be able to take care of Germany and Austria as well as other nations who will all probably want more machines than heretofore?

Considering that Switzerland, because of the war, has not been able to make her annual purchases, amounting to about $1,000,000 worth of machine tools, will Americans be prepared for the sudden and heavy demand from that country?

In conclusion, mention should be made of the economic changes which are taking place today. No manufacturer can afford to wait for the next census of 1920 to ascertain the condition of our commercial growth, for the moving finger of the statistician is daily recording significant facts which merit the earnest consideration of every machine tool builder.

One fact which demands attention is that this country is becoming a manufacturing nation; in the year 1914 our exports of food stuffs were 18 per cent as against 44 per cent in 1894, and our manufacturing products were 47 per cent of our exports in 1914 as against 23 per cent in 1894. Many other figures are available showing the growth of this country as a manufacturing nation, and having reached such a period it is necessary for us to study intensively our foreign markets and prepare to obtain that amount of export business which is indispensable to our prosperity.

* Address: National City Bank, 55 Wall St., New York City.

* * *

PLATINUM $100 AN OUNCE

The demand for platinum for utensils used in the manufacture of acids has created such a shortage that the price has risen to $100 an ounce, and very little is to be obtained at any price. The Russian, French and German governments have placed an embargo on the exportation of platinum, because of the great need of it at home. The acids that make the use of platinum utensils necessary are used in great quantities in the manufacture of war munitions. At the present price, platinum costs more than four times as much as gold. The development of chemical industries in which platinum is used, and its popularity for jewelry are two great contributing causes for the demand. During the period following the Civil War platinum was comparatively cheap. It could then be obtained for from $5 to $10 an ounce, and as late as 1905 the price was only $18.50 an ounce; in 1911 it had jumped to $46 an ounce, and in 1914 it had dropped to $42 an ounce. Since then the price has been going steadily upward, until it has reached the present unprecedented price of $100 an ounce.

* * *

Howard W. Dunbar of the Norton Grinding Co., calls attention in the October number of *Grits and Grinds* to the importance of providing belts on grinding machines of uniform thickness throughout their length. The slightest variation in thickness either where an "endless" belt is joined together or where a lacing or other material is used will set up a vibration in the parts with which the belts are connected. This vibration if of sufficient magnitude will be transmitted to the wheel or the work and the result will be chatters or mottles. This applies especially to the belts in close proximity to the wheel and work. Never replace an endless belt with one carrying wire lacing or any other form of lacing that gives a "bump" as it passes over the pulley, if smooth work is desired in finishing. Belts should be of the proper width to transmit the power required and must be maintained at a constant uniform tension. Care must be taken to prevent oil and grease from getting on the belts. Poor belting should be avoided, as it stretches in spots, resulting in uneven thicknesses and un-uniform tension.

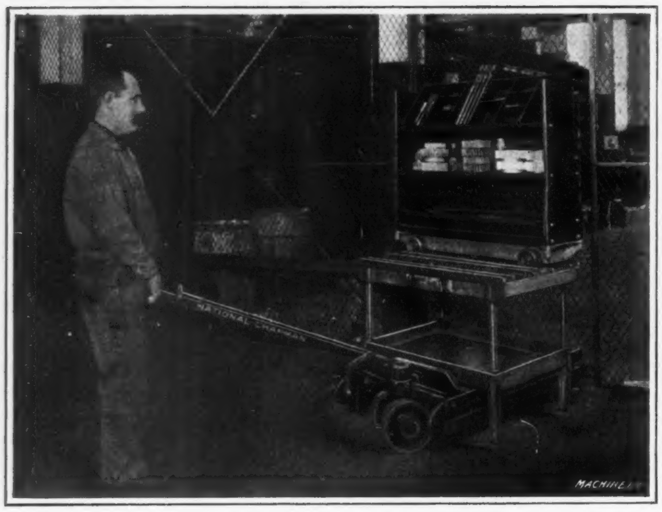


Fig. 1. Transfer Truck, Auxiliary Table, Bench Truck and Stock Rack

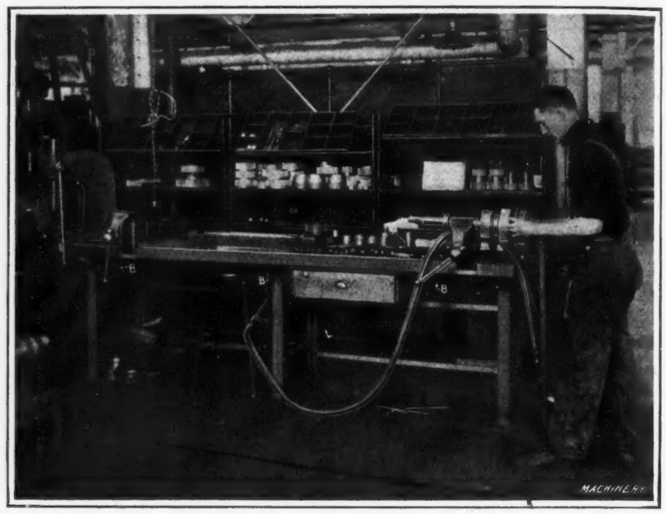


Fig. 2. Shaft Assembling Bench with Three Stock Racks in Place

ASSEMBLING METHODS OF THE JONES & LAMSON MACHINE CO.

APPLICATION OF THE HIGHLY SYSTEMATIZED METHODS OF AUTOMOBILE FACTORIES IN MACHINE TOOL WORK

BY EDWARD K. HAMMOND*

THE machine tool builder who is being shown through one of the large automobile factories is bound to be impressed by the results obtained from the highly systematized assembling methods employed in these plants. But he is likely to regard this merely as a case in which scientific management has produced gratifying results and fail to see any possibility of applying similar methods in his own shops. However, these methods are capable of wide application—after making suitable modifications to adapt them to existing conditions. It is the purpose of the present article to describe the way in which such highly systematized assembling methods were applied in the factory of the Jones & Lamson Machine Co., Springfield, Vt., and the conditions which led to their employment. Credit for the development of this plan is due to Ralph E. Flanders, general manager of the firm.

It is an axiom of factory administration that the greatest return will be obtained from labor by arranging working conditions in such a manner that the men will be required to move about the shop as little as possible. The method of assembling which is to be described in the following article is employed on all parts which go to make up the headstocks of Jones & Lamson flat turret lathes, including the shafts for the lathe headstocks. A study of the methods of assembling formerly employed in the factory revealed the fact that a large amount of time was spent by the men in going to the store-room for supplies, in delivering the work which they had completed to the next department, and in various wasteful ways which were fostered by the conditions existing in the shop. A further defect lay in the fact that it was difficult to keep an accurate record of the supplies used.

With the view of overcoming these difficulties it was decided to develop a method which would provide for delivering the necessary parts to each man employed in the assembling department, so that he could carry on his work without the necessity of going to the stock-room. There are two obvious advantages in such a plan; the possible loss of parts is avoided and the time of the assembler is saved, as the delivery of parts from the stock-room can be looked after by a boy whose time is of little value. The assembling department was then laid out in such a way that the work would move in a continuous circuit, and its transfer be simplified as far as possible.

It has been mentioned that the method is employed in assembling lathe headstocks, and in the department where this work is done each employe is assigned to a bench fitted with a vise, arbor press and the necessary tools. The parts are transferred from the stock-room to the assembling department in bins, each of which carries all the necessary gears and other parts required for one or more complete shafts or other unit assemblies. The bin in which these parts are contained is supported on a small truck carried on the stand shown in Fig. 1, which is made so that it

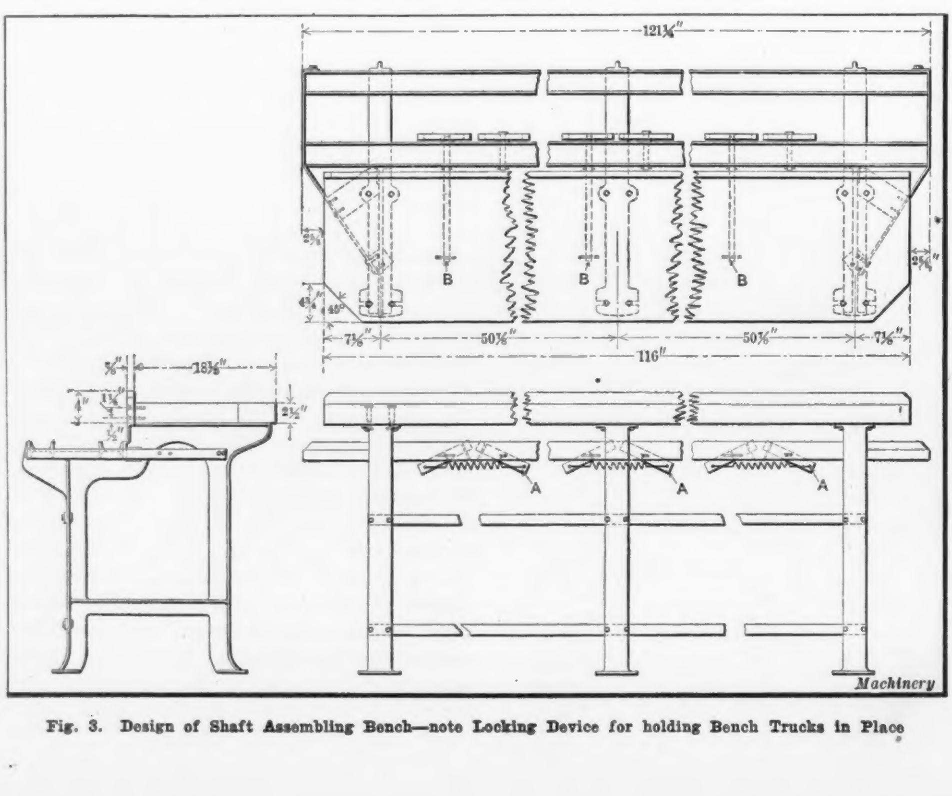


Fig. 3. Design of Shaft Assembling Bench—note Locking Device for holding Bench Trucks in Place

* Associate Editor of MACHINERY.

may be conveniently moved by an elevating truck.

Fig. 2 shows a view of one of the shaft assembling benches; the truck carrying a bin full of supplies is backed up so that the tracks on the stand are in line with tracks located at the back of the assembling bench. The latch which holds the small truck in place on the stand is then released and this "bench truck," as it is called, is then run onto the tracks on the bench and locked in place. At the time a bin full of parts is delivered to the assembling bench, a truck and empty bin is run off at the opposite end of the bench and returned to the stock-room where it is filled with parts ready for delivery. Each bin full of parts is delivered from the stock-room against a signed order from the foreman of the assembling department.

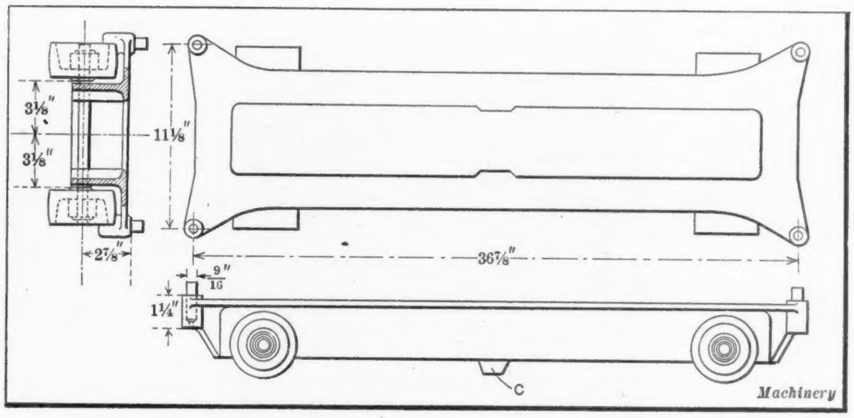


Fig. 4. Design of Bench Truck used for supporting Stock Racks

Construction of Assembling Benches and Bench Trucks

Fig. 3 shows a plan view, and front and end elevations of one of the assembling benches. It will be seen from this illustration that the tracks for the bench trucks are located slightly below the working surface of the bench for the purpose of bringing the lowest compartments of the stock bins level with the bench and placing all compartments within easy reach of the operator. It will be evident that some provision must be made for securing each of the bench trucks in place. This is effected by latches *A* which engage each side of a lug cast on the bottom of the truck body. When a truck is run into place on the bench or moved from one station to another, the latches *A* are released by turning handles *B* which cause the latches to drop to a horizontal position and release the lug on the truck. Plan, elevation and cross-sectional views of one of the bench trucks are shown in Fig. 4, and the lug provided for locking the truck in place on the bench is shown at *C*.

It will be seen that the front corners of the bench are beveled off, the purpose being to enlarge the opening between adjacent benches so that it is an easy matter to back the elevating trucks into place. Cleats are provided on the floor at the end of each bench which engage the legs of the stands on which the bins are brought out from the stock-room, thus locating them in such a position that the tracks are in line with the tracks on the assembling bench. Fig. 1 shows a stand with two sets of tracks, it being originally intended to send out two bins full of parts at a time, but subsequent experience showed this idea to be impractical, and new stands are now being made which only provide for carrying a single bin. These stands will be arranged with wheels so that the use of the elevating truck will be dispensed with.

Taking the Machine to the Work

The idea of making it unnecessary for the workmen to leave their places in the factory has been carried a step further by providing portable drilling machines for use in the assembling department. One of these machines is shown in Fig. 7, and reference to this illustration will show that the equipment consists of an "Avey" bench drill, made by the Cincinnati Pulley Machinery Co., which is mounted on a stand used in connection with an elevating truck. It will be evident that the individual motor drive makes it possible to connect with the electric circuit in any part of the shop where the machine is to be used. The need of a drilling machine in the assembling department is due to the fact that it is necessary to drill pin holes in the shafts at the time the assembling is done in order to get exactly the required relation between the different parts for the machines.

In the single-spindle Jones & Lamson lathe there are five shafts in the headstock and these shafts are not only of different sizes, but some of them are of different sizes at opposite ends. On this account, special arrangements must be made for supporting each of the shafts in a horizontal position on the drill press table. A universal V-block fixture, shown in Fig. 7, provides for holding all classes of shafts, the arrangement consisting of V-blocks which may be adjusted vertically in order to bring them to the required position; and before starting to drill a hole the position of the work is tested with a spirit level to see that the shaft is exactly horizontal. It has been mentioned that the stands on which these drilling machines are mounted are so designed that an elevating truck may be used for moving the machine about the factory; but as in the case of the stands for the stock bins, it is intended to apply wheels so that the use of a truck will be unnecessary.

The head assembling department of the Jones & Lamson Machine Co. occupies one complete bay in the factory and is arranged with a row of benches down each side. There are two types of lathe heads to be assembled, *i. e.*, the heads of the single-spindle and double-spindle machines, and the assembling of these two types of heads is done on benches located at opposite sides of the bay. The conditions are essentially the same in both cases, so it will merely be necessary

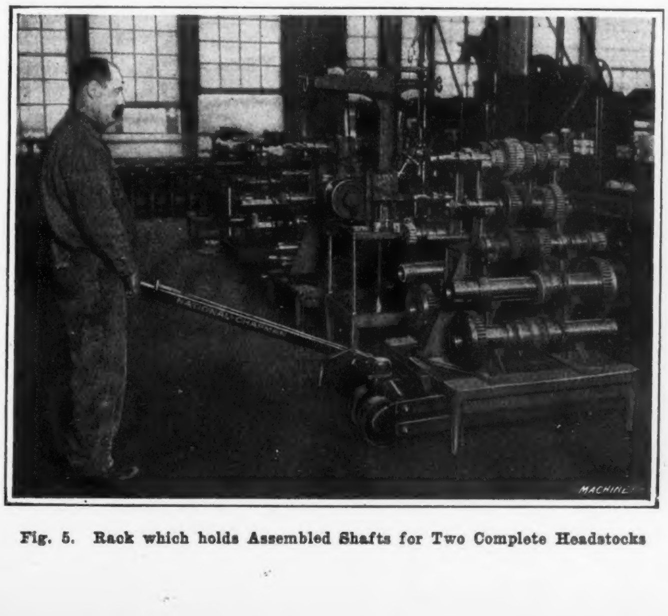


Fig. 5. Rack which holds Assembled Shafts for Two Complete Headstocks

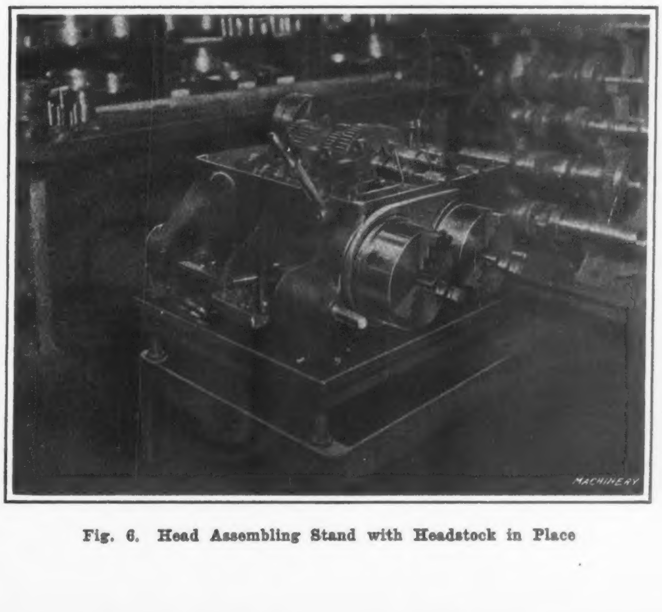


Fig. 6. Head Assembling Stand with Headstock in Place

to refer to one class of work; the assembling of headstocks for the single-spindle machines has been selected for the purpose of description. There are two benches on which are assembled all the shafts for the lathe heads, and two benches for the use of the men employed in fitting and assembling these shafts and other parts into the headstock castings.

The method by which the parts are delivered from the stock-room has already been referred to, and there is little more to be said about the work of assembling the shafts beyond the fact that special stands are provided on which the complete shafts are stacked pending their delivery to the men who assemble them in the headstocks. One of these racks is shown in Fig. 5, from which it will be seen that brackets are provided for holding the shafts, these brackets being faced with soft brass to prevent scoring the bearings. Each rack has a capacity for holding the shafts required for two complete headstocks, and represents a normal day's work of one assembler. As the factory is at present turning out four single-spindle lathes a day, it will be obvious that it is necessary to have two men employed in assembling shafts. The output of these two men is passed along to the two head assemblers where the bearing linings are fitted into the headstock castings and the shaft is assembled in place. Special assembling stands are used to support the work, as shown in Fig. 6, and electric hoists are provided on each side of the assembling department to assist the men in lifting heavy parts, one of these hoists being shown in Fig. 8. These hoists are arranged on I-beam trolleys which extend the whole length of the bay directly over the space in which the assembling stands and shaft racks are located, so that the hoists may be used if necessary at any bench. It should be noted, however, that they are in general use only at those benches where the headstock castings themselves are handled, as shown in Fig. 8, inasmuch as every item of the equipment, with the exception of the assembling benches, is arranged to be moved by elevating trucks.

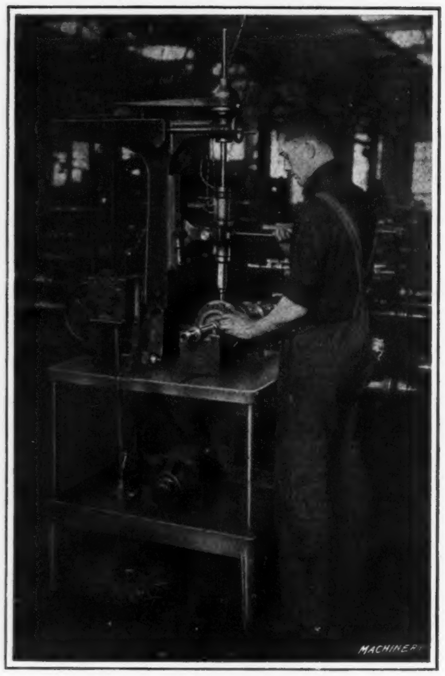


Fig. 7. Portable Drilling Machine with Adjustable V-block Fixture for holding Shafts

Testing the Assembled Headstocks

After each headstock has been completely assembled, it is left in position on the stand and taken to the testing department, which is located at the end of the bay where the lathe heads are assembled. In the testing department there are electric motors on the floor, to which the headstocks are belted to provide for making running tests. The legs of the stand carrying the headstock are brought into contact with cleats on the floor which locate the stand and headstock in the proper relation to the driving motor. Each headstock is driven for three or four hours to "run in" the bearings and gears, and to be sure that all parts of the mechanism operate smoothly. The headstock is then ready to be taken on to the department in which the assembling of the machines is conducted.

Criticisms of scientific management are often made on the grounds that the cost of installation is high, that it complicates the routine work of the factory, and that the benefits obtained do not justify the trouble and expense that have been involved. In some cases these contentions are undeniably true, but in the present instance it will be evident that the cost of installing the method was relatively low and the work of assembling has been greatly simplified rather than complicated. A concrete idea of the actual benefits resulting will be gathered from the fact that four men are now able to do the work for which ten were formerly required.

It will be noted that, with the exception of the bench top, all the equipment is of metal throughout. It could have been made very much more cheaply and quickly in wood, but it is the policy of the shop to taboo wood wherever possible, from the standpoint of avoiding all fire risks. The shaft racks, in particular, are somewhat heavier than conditions require, and in making further additions to the equipment they would be considerably lightened.

It is the hope to extend this method of handling the assembling still further as opportunity offers, possibly to the handling of the machines themselves, as well as to the handling of the component parts.

* * *

INGENIOUS FLASHING SIGNS

An ingenious and effective development of electric signs is now appearing in the larger cities. The signboard is composed of horizontal and vertical rows of incandescent lights closely spaced. Any letter, figure or device can be shown in light by switching in the lamps in the required area on the board. This feature of the sign, of course, is old, but the novel feature is that the words travel along the sign, appearing at the right and sliding off at the left. The effect is startling and fascinating. Words, phrases and sentences appear, the letters moving at a rate that easily enables one to follow the meaning until the legend is completed.

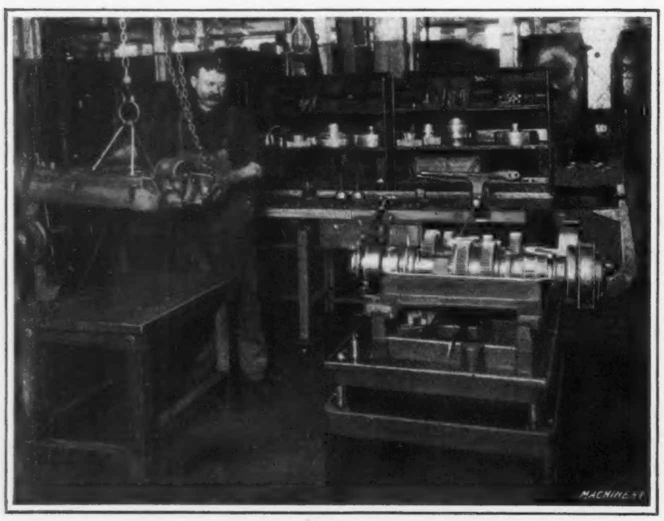


Fig. 8. Head Assembling Bench and Hoist provided for lifting Castings

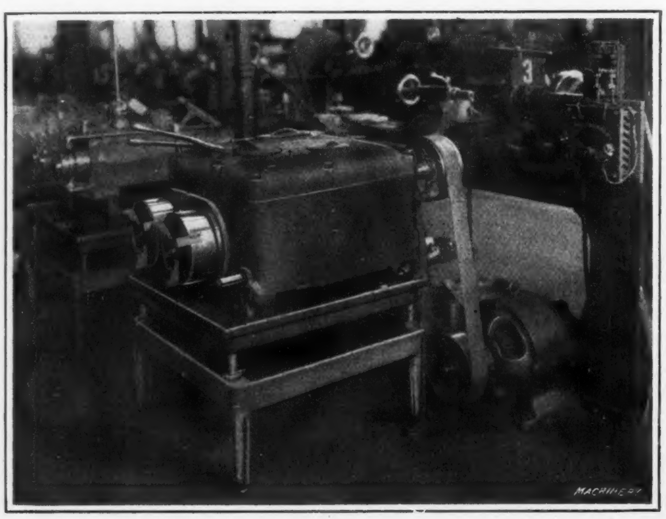


Fig. 9. Stand located by Cleats on Floor to align Headstock and Motor

BENDING SHEET METAL FOR METAL FURNITURE

DATA FOR MAKING CORRECTIONS IN CUTTING BLANKS FOR REVERSED AND SQUARE BENDS

BY K. GEORGE SELANDER*

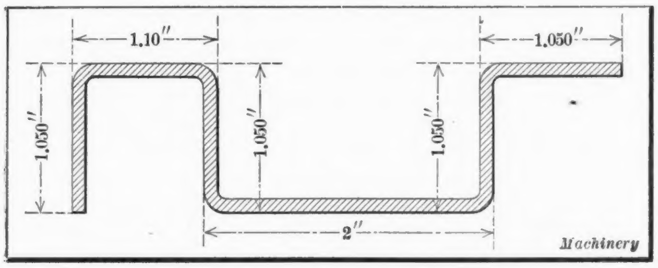


Fig. 1. Cross-section of Sheet Metal Bend dimensioned according to Old Method

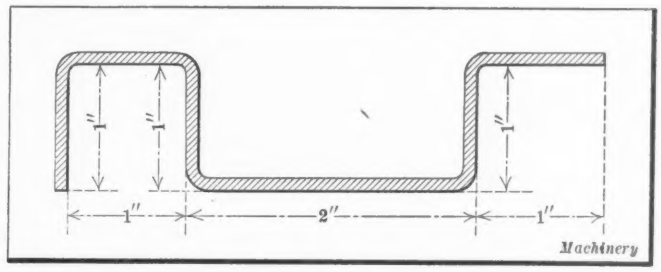


Fig. 2. Cross-section of Sheet Metal Bend dimensioned according to New Method

IN the May, 1911, number of MACHINERY, I contributed an article entitled "Bending Sheet Metal for Metal Furniture," in which a table was presented that gave the proper allowances to make for the bends when cutting up sheet metal. Since that time I have compiled new tables that give data on allowances for square and reversed bends, which will be found particularly valuable in the metal furniture trade on account of the great variety of bends that have to be made and the different gages of metal that are used. The data presented in these tables are based upon the same formula that was used in calculating the results presented in May, 1911. This formula is as follows:

$$1.67 \times \text{number of bends} \times \text{gage} = X$$

where X is the amount to be deducted from the sum of the outside bend dimensions, to compensate for elongation.

Using the table presented in my previous article, it would be necessary to know the dimensions shown in Fig. 1 and to deduct for five bends in sheet metal of the proper gage, in order to arrive at the required length of blank to cut off. Fig. 2 shows the dimensions given in accordance with the method followed in the present tables, and it is important that the dimensions should not be given as shown in Fig. 1, owing to the system which is now employed. Bends on the side the dimensions are given on in Fig. 2 are considered square bends, and those on the opposite side reversed bends. It is immaterial on which side the dimensions are placed, as the result will be the same in either case. In determining the required length of stock to cut off, the method of procedure is as follows: Count the number of bends on the dimension side of the illustration, which is two in the case of the work shown in Fig. 2. Next count the number of bends on the opposite side, which is three. The total sum of all dimensions given is 7 inches. Now referring to the first vertical column of Table II for the horizontal line 2-3, and for the vertical line for 18 gage stock, it will be found that 1/8 inch must be deducted from 7 inches, making the proper cutting length for the blank 6 7/8 inches.

As a further example in the use of this method, consider the case of the bend shown in Fig. 3. Here the sum of the dimensions given is 8 inches, and there are two "square" bends and four "reversed" bends. Referring to Table II for 2-4 and 13 gage stock, it will be found that 3/16 inch allowance for bending must be deducted from 8 inches, making the required length of blank 7 13/16 inches. The tables are figured out in the following manner: The sum of the dimensions in Fig. 3 is 8 inches and to this we add twice the thickness of 13 gage stock for four bends, which is found to be $8 \times 0.0938 = 0.7504$ inch. This amount is next added to 8, which makes the length 8.7504 inches.

* Address: Care of Art Metal Construction Co., Jamestown, N. Y.

TABLE I. CORRECTIONS FOR BENDS IN CUTTING BLANKS FOR SHEET METAL WORK

Square and Reversed Bends	Gage of Metal and Thickness in Inches								
	0.025 24	0.0313 22	0.0375 20	0.05 18	0.0625 16	0.0781 14	0.0938 13	0.1094 12	0.125 11
1—1	1/32	1/32	3/64	1/16	3/32	3/32	1/8	5/32	3/16
2—1	3/32	3/32	1/8	5/32	3/16	7/32	9/32	5/16	3/8
3—1	1/8	5/32	3/16	1/4	5/16	11/32	7/16	1/2	19/32
4—1	5/32	3/16	1/4	5/16	13/32	15/32	19/32	11/16	25/32
5—1	3/16	1/4	5/16	13/32	1/2	19/32	3/4	7/8	1
6—1	1/4	9/32	3/8	1/2	19/32	23/32	29/32	1 1/16	1 7/32
7—1	9/32	11/32	13/32	9/16	23/32	27/32	1 1/16	1 7/32	1 13/32
8—1	..	..	..	..	..	..	..	..	..

Square and Reversed Bends	Gage of Metal and Thickness in Inches								
	0.025 24	0.0313 22	0.0375 20	0.05 18	0.0625 16	0.0781 14	0.0938 13	0.1094 12	0.125 11
1—2	1/32	1/32	1/32	1/16	1/16	1/16	3/32	3/32	1/8
2—2	1/16	3/32	3/32	1/8	3/16	3/16	1/4	9/32	11/32
3—2	1/8	5/32	5/32	7/32	9/32	5/16	13/32	15/32	17/32
4—2	5/32	3/16	7/32	5/16	3/8	7/16	9/16	21/32	3/4
5—2	3/16	1/4	9/32	3/8	15/32	9/16	23/32	13/16	31/32
6—2	1/4	5/16	11/32	1/2	19/32	11/16	7/8	1	1 5/32
7—2	9/32	11/32	13/32	9/16	11/16	13/16	1 1/32	1 3/16	1 3/8
8—2	5/16	3/8	15/32	5/8	25/32	1	1 3/16	1 3/8	1 19/32

Machinery

TABLE II. CORRECTIONS FOR BENDS IN CUTTING BLANKS FOR SHEET METAL WORK

Square and Reversed Bends	Gage of Metal and Thickness in Inches								
	0.025 24	0.0313 22	0.0375 20	0.05 18	0.0625 16	0.0781 14	0.0938 13	0.1094 12	0.125 11
1—3	1/64	1/64	1/64	1/32	1/16	1/16	1/16	1/16	1/16
2—3	1/16	3/32	3/32	1/8	5/32	5/32	7/32	1/4	9/32
3—3	3/32	1/8	5/32	3/16	1/4	9/32	3/8	7/16	1/2
4—3	5/32	3/16	7/32	9/32	11/32	13/32	17/32	5/8	23/32
5—3	3/16	7/32	9/32	3/8	15/32	17/32	11/16	25/32	29/32
6—3	7/32	9/32	11/32	15/32	9/16	21/32	27/32	31/32	1 1/8
7—3	17/64	5/16	13/32	17/32	11/16	25/32	1	1 5/32	1 11/32
8—3	..	..	..	..	..	..	..	..	..
9—3	..	..	..	..	..	..	..	..	..

Square and Reversed Bends	Gage of Metal and Thickness in Inches								
	0.025 24	0.0313 22	0.0375 20	0.05 18	0.0625 16	0.0781 14	0.0938 13	0.1094 12	0.125 11
1—4	0	0	1/64	1/64	1/32	1/32	1/32	1/32	1/32
2—4	3/64	1/16	1/16	3/32	1/8	1/8	3/16	7/32	1/4
3—4	3/32	1/8	1/8	3/16	7/32	1/4	11/32	13/32	15/32
4—4	1/8	5/32	3/16	9/32	11/32	3/8	1/2	9/16	21/32
5—4	5/32	7/32	9/32	11/32	7/16	1/2	21/32	3/4	7/8
6—4	7/32	9/32	11/32	7/16	17/32	5/8	13/16	15/16	1 3/32
7—4	1/4	5/16	13/32	17/32	21/32	13/16	31/32	1 1/8	1 9/32
8—4	5/16	3/8	1/2	19/32	3/4	15/16	1 1/8	1 5/16	1 1/2
9—4	..	..	..	..	..	..	..	..	..

Machinery

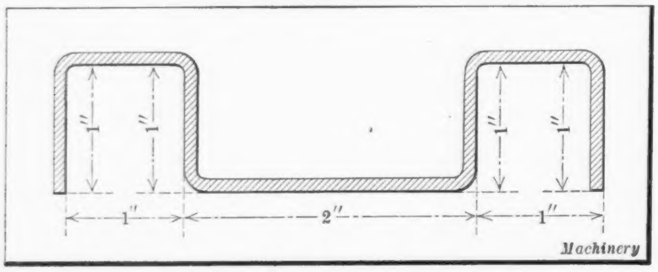


Fig. 3. Cross-section of Sheet Metal Bend considered in Second Example

From this we deduct the elongation allowance for six bends in 13 gage stock—as given in the table previously published —which is found to be 0.9375 inch. The remainder of 7.8129, or 7 13/16 to the nearest fraction, is the proper cutting length. Subtracting 7 13/16 from 8 gives a remainder of 3/16 inch, which is the allowance given in the table. The preceding examples show the advantage of the use of a table of this character, and in this connection it may be stated that the results are reasonably correct for sheet steel, brass, bronze, and aluminum plates. It is assumed that the bending will be done under ordinary pressure conditions and that a V-die will be used. In calculating regular "square" bends, the table presented in my previous contribution should be used; this table will also be found in MACHINERY'S HANDBOOK.

TABLE III. CORRECTIONS FOR BENDS IN CUTTING BLANKS FOR SHEET METAL WORK

Square and Reversed Bends	Gage of Metal and Thickness in Inches								
	0.025 24	0.0313 22	0.0375 20	0.05 18	0.0625 16	0.0781 14	0.0938 13	0.1094 12	0.125 11
1—5	0	0	0	0	0	0	0	0	0
2—5	1/32	3/64	1/16	3/32	3/32	1/8	5/32	3/16	7/32
3—5	3/32	1/8	1/8	3/16	7/32	1/4	5/16	11/32	13/32
4—5	1/8	5/32	3/16	1/4	5/16	13/32	15/32	17/32	5/8
5—5	5/32	7/32	1/4	11/32	13/32	17/32	5/8	23/32	27/32
6—5	3/16	1/4	5/16	13/32	17/32	21/32	25/32	29/32	1 1/32
7—5	1/4	5/16	3/8	1/2	5/8	25/32	15/16	1 3/32	1 1/4
8—5	9/32	3/8	7/16	19/32	23/32	29/32	1 3/32	1 1/4	1 15/32

Square and Reversed Bends	Gage of Metal and Thickness in Inches								
	0.025 24	0.0313 22	0.0375 20	0.05 18	0.0625 16	0.0781 14	0.0938 13	0.1094 12	0.125 11
1—6	0	0	0	0	0	0	+1/32	+1/32	+1/32
2—6	1/32	1/32	3/64	1/16	3/32	1/8	1/8	5/32	3/16
3—6	1/16	3/32	1/8	5/32	3/16	1/4	9/32	5/16	3/8
4—6	3/32	5/32	3/16	1/4	9/32	3/8	7/16	1/2	19/32
5—6	5/32	3/16	1/4	5/16	3/8	1/2	19/32	11/16	25/32
6—6	3/16	1/4	5/16	13/32	1/2	5/8	3/4	7/8	1
7—6	1/4	5/16	3/8	1/2	5/8	3/4	29/32	1 1/16	1 7/32
8—6	9/32	3/8	13/32	9/16	11/16	29/32	1 1/16	1 1/4	1 13/32

Machinery

* * *

"CLEARANCE" AND "ALLOWANCE"

The expressions "clearance" and "allowance" may generally be used interchangeably as terms signifying the difference between working parts to admit of motion and lubrication. In other words, the clearance or allowance is the space between adjacent parts, whether this space is allowed merely to avoid interference or in order to obtain different classes of fits. The clearance allowed between different parts is governed by the conditions under which the parts work. In the best drafting-room practice, the clearance is taken into account when giving the dimensions of individual parts, and is indicated on the drawing as the actual size of the part. For example, if the hole for a shaft is 2 inches in diameter and the clearance or allowance on the shaft is to be 0.002 inch, then the diameter of the shaft should be given as 1.998 inch. If it is permissible for the diameter of the shaft to be 0.0005 inch larger or smaller than this dimension, then the latter value indicates the *limit* of accuracy, and the dimension is given as 1.998 ± 0.0005 inch.

* * *

EFFECT OF VIBRATION ON MACHINE EFFICIENCY

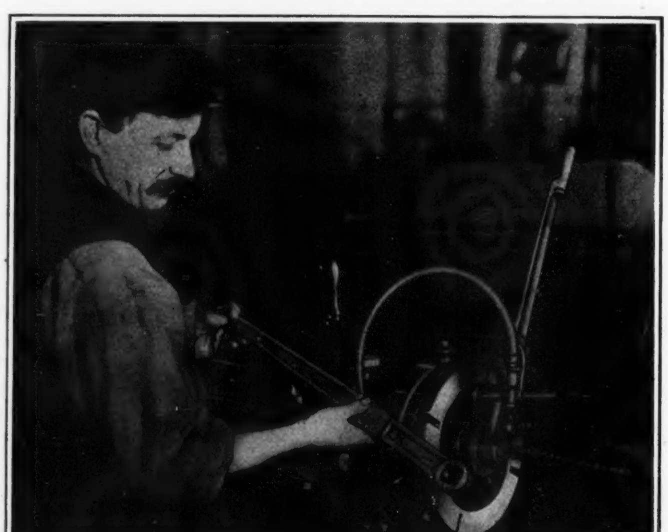
It is generally recognized that machinery of all kinds, and machine tools especially, operate most efficiently when set on solid foundations. Where it is necessary to place machinery on the upper floors of factory buildings, great care must be taken to have the working parts in balance, as otherwise the working of the machine will set up vibrations destructive to efficient cutting action and finish. In some cases, it is necessary to provide false foundations in the form of large masses of concrete or other dense material that deadens the vibrations.

Recognizing that higher speed, greater work and human efficiency are promoted by a condition of stability, as compared with that of constant vibration in buildings, but that exact data proving this fact are difficult to obtain, the Aberthaw Construction Co., Boston, Mass., has undertaken an exhaustive investigation in the effort to bring together conclusive evidence. The company will greatly appreciate any suggestions or reports of experience that would be useful in this connection. Experiences on any aspect of the case will be accepted if they will assist in the reaching of definite conclusions.

* * *

BROACHING SQUARE TAPER HOLES IN A BRAKE LEVER

The brake lever in the Pierce-Arrow motor car is secured to its shaft by a square taper seat, being bolted in place. The method by which this square taper hole is cut at the plant of the Pierce-Arrow Mfg. Co. in Buffalo, N. Y., is interesting. The operation is performed on a J. N. Lapointe broaching machine, as illustrated in the view shown herewith. A faceplate fixture, having four slots equi-distantly spaced around the circumference, is clamped on the head of the machine at the proper angle of the taper. The brake lever is first drilled with as large a hole as possible, and before being put on the machine is fitted with a removable steel key that engages one of the four slots just mentioned. The broaching cut is started with the lever in one of the four positions. A cut is taken that cleans out one corner of the hole at the required taper, and the lever is then shifted to the next position and a second cut taken. This procedure is followed until the four cuts have been made, when the lever is removed from the faceplate and the key taken off and fitted to another lever. The result is an extremely clean and well finished hole. The operation does not require a skilled operator. C. L. L.



Square Taper Broaching Operation

RECENT LEGAL DECISIONS INVOLVING MACHINERY

Discharge of Agent for Acceptance of Gratuities from Seller

(Missouri) There is believed to exist among manufacturers a custom of offering more or less slight tokens of appreciation to buyers representing concerns purchasing their wares. There is reason to believe also that frequently such gratuities are accepted. While the moral phase of the question has doubtless been much debated, the courts have seldom been called upon for their view of the proposition.

In the case of Wade v. William Barr Co., reported from the St. Louis Court of Appeals, the question is, "Can an agent, intrusted with discretionary power in the purchasing of machinery for his principal's account, accept, without his principal's knowledge and consent, presents or gratuities of substantial value, consistently with the confidence reposed in him?" and is declared to be a question for the jury.

"The jury had the evidence of the whole transaction before them, the amount of the gifts, the amount of the dealings of plaintiff with those from whom he purchased for defendant, as well as the times when, and circumstances under which, they were given. They were all given at Yuletide; were Christmas gifts; given at the time when all the world is full of charity and good will; when, as we are told, even soldiers in opposing trenches and in deadly struggle stop and make gifts. Who would say that in such acts these soldiers were disloyal to their cause? All the facts being present as here, the issue tendered as here, in an action at law as here, it was for the jury to say whether, on these facts, they, 'as reasonable men,' 'acting reasonably,' would say the gifts were 'substantial gifts' and were bribes; whether under color of gifts at such a time and of such character, a corrupting motive lay back of their giving or receipt. We decline to say here, as a matter of law, that, on the evidence, the receipt of such gifts, under like circumstances, is to be conclusively held to be an act justifying the discharge of the agent. In brief, we hold that, on its facts and issues made, this was a case for the jury." *(Wade v. William Barr Co., 177 S. W. 668.)*

New York Smoke Nuisance Law Not Effective in New Jersey

(New York) The resulting effect in New York of a nuisance in another state is not punishable in New York according to the holding in Richmond Co. court in People v. International Nickel Co.

Smoke and noxious vapors from defendant's factory in New Jersey were blown over to New York "injuring a considerable number of persons."

In disposing of the case the court said: "The serious question presented here is whether or not the acts constituting the crime as defined by this section occurred within the limits of the state of New York. The indictment clearly sets forth that all of the acts complained of, as a result of which the gases and other deleterious fumes were wafted by the winds to the county of Richmond, occurred in the city of Bayonne, state of New Jersey. I fail to find from a close examination of the indictment that the defendant has done or failed to do any act or acts within the boundaries of the state of New York that would give this court jurisdiction.

"It is undoubtedly true, as contended by the learned district attorney, that the result or effect of the acts of the defendant corporation done in the state of New Jersey is felt in the county of Richmond and state of New York, and causes annoyance to the inhabitants thereof, which acts, resulting in the same annoyance, if committed within the county of Richmond or the state of New York, would constitute a nuisance as defined by this section of the Penal Law. Can the defendant, therefore, be indicted for the effect or results of its acts irrespective of the acts themselves? I think not. *(People v. International Nickel Co., 155 N. Y. S. 156.)*

No Property Rights in Machine Patent

(Federal) Where plaintiff contracted to invent and manufacture certain special bottling machinery for defendants, the contract providing that the defendants should have an interest in the machines or in any patents thereon only when such machines conformed with the contract, and they did not come within the stipulations, either in output capacity or operative cost, the contract further providing that upon such failure it should be deemed ended, there being no provision giving the defendants an interest in any machines, except upon compliance with the stipulations and payment for fifteen sets, a conveyance of any letters patent, drawings, etc., from plaintiff being expressly conditional upon the payment of a royalty, defendants, declining to accept the completed machinery as a compliance with the contract, could claim no property right in it, or in patents covering it. *(Burpee v. Guggenheim, 226 Fed. 214.)*

Machinery must be Moved with Proper Appliances

(Alabama) Where the superintendent of a machine shop knew that a servant was inexperienced in handling, or assisting in handling, heavy machinery—the work in which he was engaged—such superintendent was under duty to instruct the servant as to the proper mode of working.

The servant may recover for injuries received by the crushing of his foot under heavy machinery which he was assisting to move. Such recovery is on the theory that an employe is entitled to a safe place in which to work. The machinery in this case was moved by use of a tie and wedge instead of rollers which the court believed would have been the proper method. *(Alabama Fuel & Iron Co. v. Ward, 69 S. 621.)*

Use of Defective Appliance

(Nebraska) Where a transportation company employed for a consideration to move a heavy machine from the factory of a manufacturer to the freight depot of a railroad furnishes a broken or defective appliance for that purpose, by reason of which one of the servants of the manufacturer is injured while assisting in an effort to place the machine on the wagon of the transportation company, the last-named company is liable for damages to the person injured. *(Wiseblood v. Omaha Merchants' Express & Transfer Co., 154 N. W. 538.)*

Suitable Power Machinery must be Provided

(North Carolina) The rule that the master must exercise ordinary care to provide a reasonably safe place to work in and furnish safe and suitable tools and appliances applies chiefly to power machinery, and not to simple tools or to ordinary conditions requiring no special care or provision, where the defects are readily observable and where there is no good reason to suppose that injury will result.

Where a car repairer was injured by the falling of a box car in which he was replacing a rotten sill, he and his associate being in full control with power to choose their own methods of doing it, that the company did not remove rubbish accumulated around the car, not being the proximate cause of the injury, constituted no breach of duty of furnishing a safe place to work in. *(Bunn v. Atlantic Coast Line R. R., 86 S. E. 503.)*

* * *

ENAMEL FOR PRESERVING STEEL AGAINST RUST

Bitumastic enamel is a compound which is considered one of the best preparations available for the preservation of steel against the influence of the weather in bridges, cranes, roofs and ships, and other structures of iron and steel. The only manufacturer of this compound is Wailes, Dove & Co., Newcastle-on-Tyne, England. Bitumastic enamel was selected by the engineers of the Panama Canal out of three hundred compositions which were submitted to endurance tests, to protect the steel lock gates and other steel structures used in connection with the canal. The total area of steel surfaces covered by this compound is equal to about 70 acres.

* * *

German silver, also known as nickel-silver, is an alloy of copper, nickel and zinc, the best quality consisting of 50 per cent copper, 25 per cent nickel, and 25 per cent zinc. This quality, however, is the most difficult to work, but it takes a fine polish and is frequently used for tableware to imitate silver. When the proportion of copper is somewhat higher, the alloy is suitable for rolling and for drawing into wire.

ROUGHING OUT FELLOWS GEAR SHAPER CUTTER BLANKS

MODIFICATIONS IN CONSTRUCTION OF GRIDLEY AUTOMATIC TO ADAPT IT FOR WORK WHICH WOULD OTHERWISE BE BEYOND ITS RANGE

BY EDWARD K. HAMMOND*

WHEN it becomes necessary to modify the construction of a machine tool in order to adapt it for handling a specific machining operation, the shop management should always limit the changes as far as possible. The reason for this is that it may be desired to use the machine for standard work again, and the original design is the one best suited to the requirements of general classes of work. In some cases it is possible to modify the design in such a way that the change does not limit the scope of the machine, and this is the ideal method.

A typical example of the necessity which sometimes arises for making changes in machine construction in order to provide for handling some specific operation is seen in the case of the Gridley automatic turret lathes which are used by the Fellows Gear Shaper Co., Springfield, Vt., for roughing out the blanks from which cutters are made for the Fellows gear shaper. Dissatisfaction was felt with the results obtained from the method formerly employed for roughing out these cutters, and in considering various methods which seemed to have features to commend them, the use of the Gridley automatic for roughing out the blanks appeared to have the greatest number of points in its favor. But when the subject was taken up with the firm that manufactures this machine—the Windsor Machine Co., Windsor, Vt.—it was found that the standard design did not provide sufficient capacity for producing the cutter blanks. Here was a case in which it was required to modify the construction of the machine in order to adapt it for a special class of work, and the method of making the necessary changes has been so cleverly worked out and applied that practically no limitations have been imposed upon the scope of general work which can be handled.

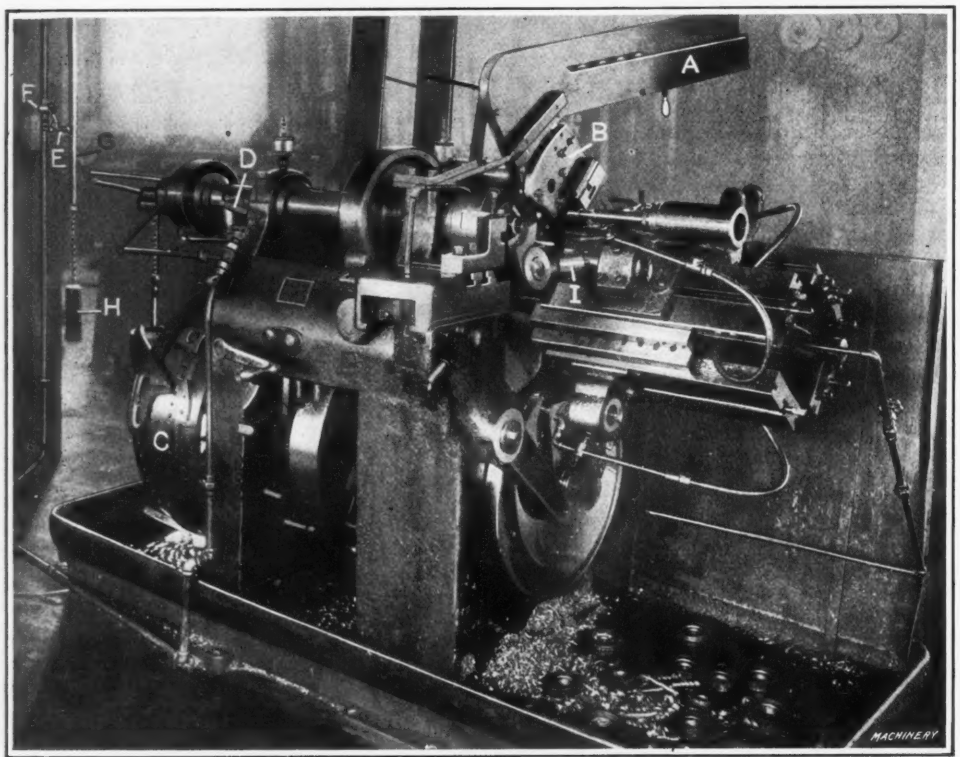


Fig. 1. Gridley Automatic equipped for roughing out Blanks for Cutters used on the Fellows Gear Shaper

Multiple-blade hacksaw machines are used to cut off the steel cutter blanks from bar stock, and in order to provide for holding these pieces it was necessary to equip the Gridley automatic with a suitable form of chuck. A Garvin three-jaw air chuck was finally selected for this purpose, but it at once became evident that if it was attempted to set this chuck up in the spindle of the machine there would be insufficient capacity between the spindle and the tool-slides. This difficulty was overcome by cutting off the nose of the spindle and mounting the chuck so that it came right back into contact with the flange on the spindle. But this change still left the machine with insufficient capacity; this was remedied by cutting off the end of each tool-slide to prevent interference between the slides and the three-jaw air chuck in which the work is held. So far as we know, this use of an air chuck on automatic machines was the forerunner of subsequent applications which have been made on a strictly commercial scale. Arranged in this way, the Gridley automatic is capable of roughing out all sizes of Fellows gear shaper cutter blanks which range from 3½ to 5 inches in diameter.

*Associate Editor of MACHINERY.

Equipment of the Gridley Automatic

The Gridley automatic equipped for this work is shown in Fig. 1; it will be seen that the blanks are held in a hopper *A* which delivers them to transfer chuck *B* carried by the regular cut-off arm on the machine. A lock-bar holds the surplus blanks back while one blank is being moved from the transfer chuck to the three-jaw air chuck on the spindle of the machine; and during the return movement of the cut-off arm, a fresh blank drops from the hopper into the transfer chuck, when it is ready to be delivered to the machine. A regular length stop of the type used when the machine is working on bar stock is employed for pushing the blank into the air chuck carried in the spindle, at the time when the blank is released from the transfer chuck. This stop is backed up by a spring plunger, instead of having its position rigidly fixed, so that means are provided to compensate for irregularities in the thickness of the cutter blanks as they are cut off from the bar. Another noteworthy feature of the set-up of this machine is that the air chuck is controlled by a cam on the drum *C* instead of being operated by hand in the usual way. This method of operating the chuck is essentially the same as that commonly employed for the control of a collet chuck for handling bar stock; and as a result, the action of the machine is entirely automatic. It will be seen from Fig. 1 that the cam is so arranged as to throw up the lever *D* which operates the valve on the air line, when it is desired to either release the work or grip a fresh blank in the chuck.

The chuck is operated by air at a pressure of 90 pounds per square inch, and the service conditions are such that it will continue to hold if the pressure drops as low as 40 pounds per inch. But it will be evident that the failure of the air pressure during the time that the machine is in operation would result in the release of the work and probable damage of the tools. Danger of trouble from this source has been overcome by the provision of an automatic belt shifting device which is controlled by the air pressure. This mechanism is shown at the extreme left in Fig. 1, where it will be seen to consist of a pointed plunger *E* which is actuated by the piston

carried in a small air cylinder *F*. As long as the pressure remains above 55 pounds per square inch—which allows a liberal factor of safety—the pointed plunger is held in place in the notched bar *G* and the machine continues to operate, but should the pressure fall below the specified limit, the plunger will be drawn back by the action of a spring, thus releasing the notched bar and allowing counterweight *H* carried by it to operate the belt shifter and stop the machine.

Sequence of Operations Performed on Gridley Automatic

The transfer of the work to the machine spindle has already been described, and the subsequent operations performed by the Gridley automatic are as follows: (1) drill center hole; (2) counterbore hole; (3) ream hole; (4) remove work from chuck; (5) face across entire blank; this is done during the time that the preceding cycle of operations is being performed.

In handling these operations the method of procedure is as follows: The drilling of the center hole in the cutter blank is performed by a special twist drill which is made in the factory from hot twisted stock. The second operation, counterboring the hole, is done with a regular Gridley offset boring tool. In the third operation, which consists of reaming the center hole, a Kelly reamer is employed that is provided with a boring tool set in advance of the reamer for the purpose of taking a roughing cut and relieving the reamer blades of the greater part of the strain. The regular stock feed is used to operate an ejector rod which performs the fourth operation of removing the work from the air chuck. The finished piece is pushed out of the chuck onto a pin *I* carried by the fourth tool-slide, and it will be seen that this pin is hinged in such a way that it drops down as the turret revolves to bring the next station into the working position, thus dropping the finished product. As the turret continues to revolve, this hinged pin swings back to the starting position, when it is ready to have the next cutter blank pushed out of the chuck onto it.

The side of the blank which is faced off on the Gridley automatic will be the top of the finished cutter, and is required to have a rake angle of 5 degrees, this result being obtained by making the required setting of the head which carries the facing tool. The feeding of the tool over the work is effected by the usual type of cam used on the Gridley automatic; this cam is illustrated in Fig. 3, and has been laid out in such a way that a uniform rate of feed is obtained for the facing tool regardless of the speed of rotation of the cam-shaft. The importance of this point will be appreciated when it is remembered that the speed of the cam-shaft varies considerably, according to whether one of the turret tools is at work or the turret is being indexed to the next working position. It will be seen that in designing this cam, the usual method of procedure was followed, *i. e.*, that of considering the complete sequence of operations as a circle. This circle was then divided up into angles representing the different operations constituting the cycle, and the magnitude of each angle was made proportional to the length of time occupied by the operation which it represents. In order to develop the outline of a cam which will provide a uniform feed for the facing tool, it was merely necessary to make the throw of the cam, as laid off on each radial line, inversely proportionate to the speed of the cam-shaft, and then connect the points located in this way.

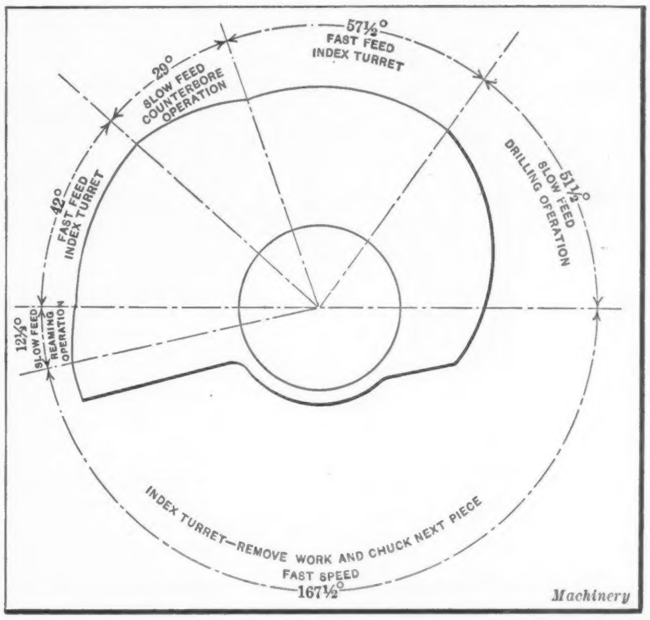


Fig. 3. Facing Cam designed to give a Uniform Rate of Feed, which is independent of Speed Changes of Cam-shaft

Equipment of Lathe for Turning Back and Edge of Blanks

In the condition in which they leave the machine, the cutter blanks are finished on one side, and the hole and counterbore have also been completely finished. It is still necessary to form the edge of the blanks and face off the under side, and for this purpose an old Jones & Lamson turret lathe was converted into a single-purpose machine. Here we have another example of the problem which the shop management faces in adapting standard machine tools for handling specific operations, but in the present case the requirements of the work were such that it was necessary to make changes which restricted the machine to handling a single class of work. The machine equipped for this purpose is illustrated in Fig. 2, and Fig. 4 shows a detailed view of the type of draw-back expanding arbor on which the work is held. In setting the work up on this arbor, the blank is slipped into place, after which the screw *A* is tightened up; this results in forcing the tapered section of the screw into its seat, thus expanding the jaws to give them the desired grip on the work. The jaws are serrated to increase their holding power as far as possible.

It will be evident that the work is quite narrow to be carried by this form of holding device, and as it is necessary to maintain a definite relation between the face of the work that was finished on the Gridley automatic and the edge of the cutter which still remains to be machined, it is necessary to provide a more positive method of location than could be obtained from the expanding arbor. This means of location is afforded by the lever *B* which governs the longitudinal movement of the arbor in the lathe spindle. To provide for setting up the work on the arbor, lever *B* is pulled back so that it forces ar-

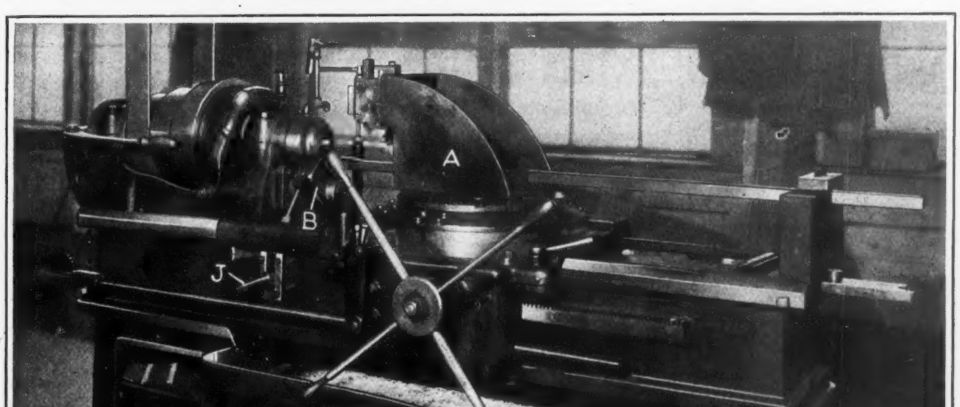


Fig. 2. Old Type of Jones & Lamson Turret Lathe especially equipped for turning Cutter Blanks

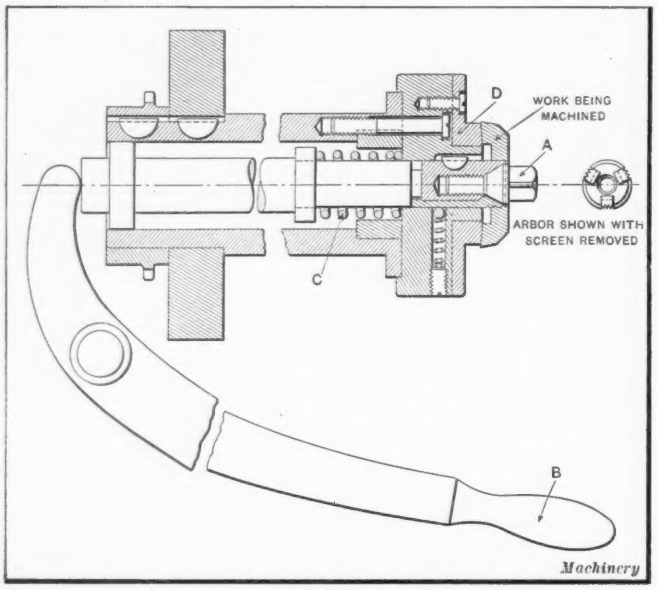


Fig. 4. Expanding Draw-back Arbor on which Cutter Blanks are mounted

bor A out against the resistance offered by compression spring C; and when lever B has been pulled back to the end of its travel, it is engaged by a lock which holds it in that position. The cutter blank is then tightened on the arbor by the method previously described, and after this the lock is disengaged from lever B, allowing the compression spring C to pull the arbor back into the lathe spindle. In so doing, the angular face of the work is drawn into contact with a corresponding face on work-holding fixture D, which results in adjusting the position of the work so that the subsequent machining operations will give the cutter blank exactly the required form.

There are three faces on the work, which still have to be finished, *i. e.*, the two beveled edges and the back face of the cutter. For this purpose two special cutter-heads are provided on the machine; the head A, Fig. 2, which is mounted on the turret carries two tools which finish the two edges of the cutter blank; and a special facing head B is provided which carries a tool for taking a finishing cut over the back face of the blank. A better idea of the way in which the machine is tooled up for the second sequence of operations will be obtained from referring to Fig. 5, which shows a close view taken from the back of the machine. It will be seen that the cutter-head A which is mounted on the turret is fitted with two slides C and D, in which the tools are carried for finishing the edges of the work. The movements of the slides which carry these tools are controlled by cams E and F which are of the proper form to provide for obtaining the required clearance and bevel on the cutter. The arrangement of the feed for the facing tool is also clearly shown in Fig. 5, where it will be seen that a horizontal shaft G at the back of the machine is belted to the cone pulley, and this shaft transmits motion to a worm H, through a pair of bevel gears. The worm meshes with a segment gear I carried at the bottom of the facing cutter-head B, and when the handle shown at J in Fig. 2 is raised to bring the worm into contact with the segment gear, it results in feeding the facing cutter across the work. This equipment gives very satisfactory results, both as regards the quality of finish obtained and the rate of production, and was made by rebuilding a machine that was too old to be an efficient producer in its original form.

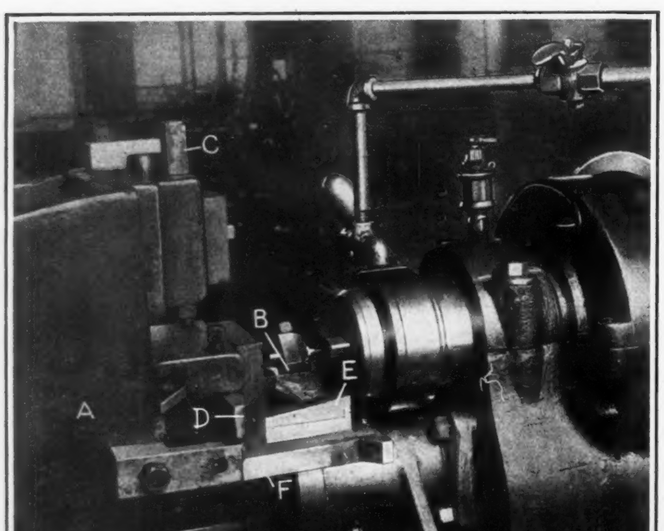


Fig. 5. Partial Rear View of Machine showing Special Feed Mechanism for Facing Tool and Means of controlling Forming Tools

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HARMONY IN MOTOR CAR DESIGN

The rapid development of motor cars during the past twenty years is one of the startling and wonderful phases of the growth of our industrial life. Starting with one-cylinder engines of three or four horsepower, we have today cars with eight- and twelve-cylinder engines, capable of developing sixty to eighty horsepower and having wonderful flexibility of control. The time is not far distant apparently when the gear shift mechanism for changing speed will no longer be needed, as the engine will have sufficient flexibility to drive the car from the slowest to the fastest speeds without gear change.

Notwithstanding this wonderful mechanical development, one cannot help feeling, after an examination of many cars shown at the recent automobile show in the Grand Central Palace, New York City, that considerable can be done yet on the lower-priced cars to improve the appearance and harmony of engine design. The difficulty of harmonizing the component parts of the motor car power plant lies in the fact that they are in many cases designed and manufactured independently. Each concern strives to make its own product as cheaply and efficiently as possible. While these units are related in purpose, they are sadly unrelated in appearance in some cases, and are incongruous when assembled. Take, for example, the vacuum feed system that is being generally adopted in order to avoid the necessity of maintaining pressure in the fuel tank. This apparatus includes a cylindrical reservoir of considerable size located near the engine. This form, of course, is the cheapest and simplest to make, but it does not harmonize at all with the rest of the apparatus under the cylinder hood. The same may be said of some other accessories that have become indispensable in modern car design.

The tendency undoubtedly will be to reconcile the design of accessories used in a group so that eventually we shall see motor car plants with harmonious lines, the various accessories fitting in appropriately and appearing to be really part of the engine and not like excresences.

* * *

PLATINUM DISCOVERED IN SPAIN

The unprecedentedly high prices for platinum that have obtained lately, because of the embargo laid on its exportation by Russia, Germany and France, gives much interest to the announcement that platinum has been discovered in Spain. Prof. Ouerta, who has examined the platinum deposits, recently made an address before the Society of Civil Engineers of Spain in Madrid, in which he stated that the deposits are of greater extent and richness than those of the Ural Mountains in Russia, from which is obtained about 90 per cent of the world's supply.

HOW MACHINERY MATERIALS AND SUPPLIES ARE SIZED*

A REVIEW OF COMMON METHODS OF SIZING SHEET METAL, WIRE, SECTIONAL SHAPES, FASTENINGS, PIPES AND FITTINGS, BELTS, ROPES, CHAINS, GEARING, ETC.

BY FRED HORNER†

THE manner in which the numerous metals, alloys, materials, fabrics, and fittings used in mechanical engineering are sized or rated for purposes of reference and ordering is an interesting subject. There is so much variation and so many apparent anomalies that the problem is somewhat confusing. Methods of sizing have in many instances been evolved in peculiar ways that have persisted to the present day, while in others more obvious and straightforward methods have been employed. Standardization, either national or sectional (that is, among certain trade associations for their own special goods) has cleared up much confusion and greatly simplified sizes, reduced their multiplicity, and made a rigid standard or limit admitting of no possible dispute. The standards for wire or sheet, and for screw threads have so revolutionized practice that it would be difficult for a machinist of this generation to believe what frightful confusion prevailed when every manufacturer had his own pet wire or sheet gage, and his own standard for screw threads. Yet this was the case in England, and to a lesser extent in the United States. Now there are recognized standard gages and threads, and ordering by number or diameter is sufficient indication to secure uniformity. In the event of dispute (due perhaps to the use of a worn gage) the micrometer caliper can always be referred to as a final appeal, since the standards are referable to decimal sizes. The micrometer is also handy for reaching over a burred or otherwise damaged edge to ascertain the true average thickness of a sheet.

The use of order numbers for goods is either of national value or is only applicable to individual firms' products. In the latter case, its utility is restricted, but it is nevertheless highly convenient for orders delivered orally or by letter or wire, and for entering upon drawings or specifications. It saves the time and trouble of writing diameters or other dimensions, sometimes indicating one principal size, or it indicates the whole thing without further specifying. In national standard sizes, as for taper pins, machine and wood screws, etc., a number always means the same identical size.

It must be remembered that sizes are not necessarily to exact standard; it depends upon the mode of manufacture of the goods, the kind of material, and very often upon the particular use to which the article is to be put. "Diameter," for example, is a very elastic term. It may be approximate, as in rough iron, in rough bolts, and in some kinds of cast work. In the case of bright-drawn steel a very close approximation to absolute dimensions is met with (considering the mode of manufacture) or in steel balls an extremely close limit is found, say 1/10,000 inch. Some screws on the other hand are purposely made over size or under size, and split cotter-pins are slightly under size to enter standard drilled holes easily.

As distinct from sizes applied in inches or numbers, a great many materials and supplies are sold in definite quantities which are always standard, comprised in some convenient form or in a receptacle or package. Substances sold by drams, ounces, pounds, hundredweights, tons or by quarts or gallons are, for purposes of sale, usually placed in receptacles containing a definite quantity, or are cast into bars, ingots, or pigs. Other materials, sold by weight or size, are collected or otherwise bundled together in suitable forms. Often a definite quantity is assembled so that it is sufficient to order by barrel, kipp, firkin, box, packet, can, bottle, sack, bale, coil, ball, hank, bundle, stone, reel, spool, etc., according to practice. Or in some cases amounts are divided into one-half or one-quarter of the specified ways of assembling. When handling loose articles, as nails, bolts, spikes, and suchlike, reference to a table will show the quantity of a certain size contained in the bulk, in keg or other container.

* For material on the sizing of machine tools and appliances, see "How Machine Tools and Appliances are Sized." in MACHINERY, February, 1915.

† Address: 13 Forester Ave., Bath, England.

The following covers the materials and supplies commonly utilized in mechanical engineering practice.

SHEETS

Material	How Sized
	By thickness in fractional or decimal parts, using some form of caliper, but more usually by standard gage, as:
Iron and Steel:	By U. S. standard gage, for sheet and plate iron and steel. (Note: A series of Roman numerals is used for rating tin plate. Corrugated sheets are listed by number of corrugations and pitch in width of sheet; expressed by symbols, as: 7/4, meaning seven corrugations of 4 inch pitch; 10/3, meaning ten corrugations of 3 inch pitch.)
Brass, Copper, Bronze, Phosphor-Bronze, German Silver, and Aluminum:	By American (Brown & Sharpe) standard. Copper sometimes by English (Birmingham) gage. (Note: Copper sheet is rated per ounce weight per square foot; as 8 ounces, or 15 ounces, or 64 ounces, etc.)
Rubber, Canvas, Various Fabrics, Paper, etc.:	Rated, like metals and alloys, by the square foot or other recognized size, or per roll of recognized width. Pieces of drawing paper are rated by sheets of certain names: Cap, 13 by 17 in. Demy, 15 by 20 in. Medium, 17 by 22 in. Royal, 19 by 24 in. Super Royal, 19 by 27 in. Imperial, 22 by 30 in. Atlas, 26 by 34 in. Double Elephant, 27 by 40 in. Antiquarian, 31 by 53 in. Bristol board is made in various sizes, including some of the above standards, and also in patent office sizes: U. S. standard, 10 by 15 in. English standard, 15 by 20 in. Some fabrics, as asbestos cloth, are rated by ounce weight per square yard. Tapes of rubber, cotton, etc., only need width specified.

RODS AND WIRE

Square, Hexagon, or Octagon Rods:	Always measured across flats, or "diameter." Twisted square rod similarly.
Rectangular Sections:	By width and thickness.
Bessemer Rods, Brass or Copper Rods:	By fractional sizes.
Drill Rods:	By Stubs steel wire gage, or by Morse twist drill gage.
Wire:	By various standards, according to material.
Bessemer Steel Wire:	By Washburn & Moen or American Steel & Wire Co. (U. S.) steel wire gage.
Steel (music) Wire:	By steel music wire gage (American Steel & Wire Co.). See also MACHINERY'S Handbook, page 391.
Brass, Copper, Bronze, Phosphor-Bronze, German Silver, Aluminum Wire:	By Brown & Sharpe gage. But practice is not yet consistent, since some firms make use of other standards, including the Stubs and the Old English or London gage.
Wire Cloth:	By "mesh" and gage of wire. The "mesh" is a term representing the number of openings per lineal inch, measurement being taken from center to center of wires. The Washburn & Moen gage is standard for iron, steel, galvanized, and coppered wires, the Old English gage for brass, copper, and bronze.
Wire Netting:	Also by mesh and gage.

SECTIONAL SHAPES

Angles:	By length of each leg, and thickness of web.
Tees:	By length, width and thickness.
Zee-Bars:	By length, length of each leg, and thickness.
Deck Bulbs:	By length and thickness.
Channels:	By length of web, and flange, and thickness of web.

Material	How Sized
I-Beams:	By depth, width, and thickness of web.
Copes and Half-Rounds:	By width and depth.
Half-Rounds (hollow):	By width, depth, and thickness.
Convex Sections:	By width and depth at center.
Rails:	By pound weight per yard. (Certain sections are sometimes specified also by pound weight per foot; this is instead of stating thickness.)
Various Sections:	When these are quite varied in contour or thickness, rating for simple identification is best understood by giving the longest width. (Note: Many ordinary sections may be most briefly specified by the longest width, i. e., a 2-inch angle, a 14-inch channel, etc.) Thickness of webs is usually measured in fractional or decimal parts, but in brass or bronze work, the Brown & Sharpe gage may be used.

FASTENINGS

Material	How Sized
Screws, Bolts and Various Threaded Articles:	The diameter of screw is the primary dimension, and is referable to one of the standard threads, but what are termed "machine screws," and also the wood screws are specified by a series of standard numbers. These are less than ½ inch diameter. As regards length, there is much variety as to the precise locations from which this dimension is determined, as follows:
Bolts:	
Hexagon, Square, Round and Ball Heads:	Length under head.
Countersink Heads:	Length over all.
Boiler Patch (cup head):	Length under head.
Boiler Patch (bevel head):	Length from largest diameter of bevel.
Hanger, Rag, and Plow Bolts:	Length over all.
Eye Bolts:	Length under neck, sometimes over all, and sometimes to center of eye.
Studs and Bolt Ends:	Length over all. (The thread on the short end of a stud is usually a little over size to make a tight fit in the hole.)
Expansion Bolts:	These are rated by the diameter of the bolt itself, not of the casing.
Machine Screws:	
Cap and Set-Screws: Collar and Thumbscrews:	Length under head (as the point of a set-screw often projects some distance beyond the threaded part, the length is always measured to the extreme point). (Note: No screw which has a head more than 1/16 inch larger in diameter than the body is classed as a "set-screw.")
Countersink:	Length over all.
Oval-Head Countersink:	Length from top of countersink to end.
Washers for Bolts or Screws:	Size of screw only need be specified if washer is standard diameter.
Wood Screws:	Diameter always rated by the screw gage.
Flat Head:	Length over all.
Round Head:	Length including about half the head (sometimes under head).
Fillister Head:	Length from under rim of head.
Coach or Lag Screws:	Length under head.
Hand-Rail Screws:	Length over all.
Screw Hooks and Screw Eyes:	Length over all.
Hooks and Eyes:	Length of hook.
Rivets:	Usually measured by English standard gage. Large sizes by fractions or decimals. (Note: Some kinds, as tinners' and coopers' rivets, are listed by numbers representing the ounce or pound weight per nominal thousand).
Ordinary Heads:	Length under head.
Countersink:	Length over all.
Oval Countersink:	Length from top of countersink.
Belt Rivets:	The length is taken to a short distance from the end (⅛ inch or more, depending on the size) or about where the burr sets after riveting.
Nails:	
Wire and Cut Nails:	By length, and in the case of wire nails, by the Washburn & Moen gage for diameter. But for convenience, all the various sizes are specified by a figure (with "d" after it), representing the weight in pounds per nominal thousand.
Railroad Spikes:	Length taken under head.
Wire Staples:	Length, and gage of wire.

MISCELLANEOUS FASTENINGS

Material	How Sized
Turnbuckles:	Size of screws and length between heads.
Belt Fastenings:	Dependent on type; sometimes by size of belt suited for, or length and width of fastening, many by number in standard sizes. Hooks and eyes for gut band rated by the diameter of band suited for.
Pipe Hooks:	By size of pipe used for. May be the "nominal bore" in the case of iron pipe sizes.
Rings for Various Purposes:	Inside diameter usually.
Keys for Shafting:	Width primary dimension, then length, usually under head for headed kinds. Thickness is taken close up at thick end.
Woodruff Keys:	Width, and thickness. (In this system each key and the cutter for milling its keyway is designated by a number or symbol).
Gibs:	Total length, and width. Depth is often taken midway, in conjunction with key.
Cotters and Spring Keys:	Width, and length from point to neck (occasionally over all).
Split Cotters:	Length under eye.
Taper Pins:	Diameter taken at large end. But ordered by numbers which also denote the standard reamers for the holes.

PIPES AND FITTINGS

Material	How Sized
Pipes and Fittings in General:	According to material and use. In what are termed the wrought iron pipe series, the rating is by nominal inside diameter, and brass tubes made to iron pipe sizes are also rated similarly. But otherwise, brass and copper tubes are measured by outside diameter. Cast-iron and steel mains are specified by internal diameter. But some kinds of steel tube, such as boiler tube, is rated outside.
Rubber, Leather, Canvas, Fiber and Flexible Metallic Tubing:	By internal diameter. (Note: When dealing with canvas or leather hose, it is convenient to refer to a table showing measurement when laid flat, such as: 1¼-inch internal diameter is 2 inches flat; 3 inches internal diameter is 5 inches flat.
Gage Glasses:	External diameter.
Elbows:	Size of pipe ("nominal iron pipe size," or actual bore for non-threaded work) and angle of openings, if not at right angles.
Offsets:	Pipe size, and amount of offset.
Nipples:	Pipe size, and length.
Various Fittings:	Primarily by pipe size, and if of flanged type (i. e., not screwed joints) by actual passage or bore.
Reducing Fittings:	Size of each outlet. (Note: When reducing sockets or other fittings, reduce to the next nearest size; it is sufficient to state the main size).
Return Bends:	Pipe size, and distance of bores, center to center.
Cross-overs:	Pipe size, and size of pipe crossed.
Tees and Branch Tees:	Size of "run" and of outlets. (Note: In specifying any class of fitting with a main passage and one or more outlets, the main passage—called "run"—is always written down first.)
Flanges:	Diameter. Pipe size sometimes stated.
Pipe Saddles and Clamps:	Pipe size.
Roller-Brackets:	Maximum size pipe carried.
Hooks and Hook-Plates:	Maximum size pipe carried and number of hooks.
Pipe Stands:	Pipe size and distance apart of centers.
Expansion Joints:	Pipe bore, and over-all dimensions.
Siphon Boxes:	Capacity, in quarts or gallons.
Water-Gages:	External diameter of glass, usually.
Pressure-Gages:	Diameter of dial, and maximum pressure.
Pyrometers:	Maximum capacity in degrees.
Oil-Cups and Lubricators:	Diameter of body.
Sight-Feed Lubricators:	Capacity in pints or gallons.
Glass Needle Lubricators:	Capacity in ounces, liquid measure.

BELTS, ROPES, CHAINS

Material	How Sized
Belting (flat or vee):	By width and thickness.
Belting (round leather or catgut):	By diameter in fractional or decimal parts. Catgut sometimes sized by Brown & Sharpe gage.
Belt Lacing:	By width.
Ropes:	By diameter.
Rope Fittings (wire rope):	Rated by size of rope used for; excepting hooks, which are listed by safe working load in tons.
Crane Chain:	By diameter of iron used in links.
Jack Chain (and similar small kinds):	By width, or by numbers, which may or may not coincide with the gage of wire used in making.
Cable Chain (for suspension and counterweighting purposes):	By width and thickness, or by safe working load.
Machine Chains (for driving):	By pitch (center to center of rivets), and width. The latter is inside the links in the case of block or roller type, but outside in the rocker-joint type.
GEARING	
Spur Wheels and Pinions:	By pitch diameter and width of face. Sometimes outside diameter is taken, with pitch and number of teeth specified.
Bevel, Miter Wheels and Pinions:	Pitch diameter in this case is taken at the large end.
Worms:	By pitch diameter, pitch and width of face.
Worm-Wheels:	The pitch diameter in this case is taken in the central plane.
Pinion Wire:	By pitch, number of teeth, and length.
Ratchet Wheels:	By pitch diameter and pitch, or outside diameter and pitch.
Racks:	By pitch, depth, and width.
Friction Spurs, Bevels, and Miters:	By largest diameter and width of face.
Gear Blanks:	By outside diameter, and width of face, but it is often just as convenient to refer to them in terms of pitch diameter, if a system is established on this basis.
Shaft Fittings:	Most fittings used in connection with shafts are sized by the diameter of latter, but pulleys are rated by diameter and width of face, and some kinds of clutches by diameter of same, or per H. P. transmitted.
MISCELLANEOUS SUPPLIES	
Lead Wire Ribbon:	By diameter of the wires.
Copper Jointing Rings:	By size of pipe, or inside and outside dimensions.
Pipe Coverings:	By outside diameter of pipe.
Flange Covers:	By diameter of pipe and of flange.
Gage-Glass Washers and Cones:	By size of glass used for.
Hydraulic Leathers:	By outside diameter in the case of cup and U-leathers, the latter sometimes inside. Flange or hat leathers by inside diameter.
Leather Fillet (for patterns):	By the radius, with a series of numbers corresponding to sixteenths of an inch, thus: No. 1. 1/16-inch radius. No. 2. ⅛-inch radius. No. 3. 3/16 inch radius. No. 4. ¼-inch radius, etc.
Pattern Letters:	Length of face (as letters are beveled, the length at base is in excess of this, by 1/16 inch or more).
Pattern Dowels:	Diameter of peg.
Dowel Plates:	Length of plate.
Rapping Plates:	Length and width. Or sometimes by the size of tapped hole.
Stars (for tumbling):	Distance from point to point.
Fire-Bricks:	Length, width, and thickness. Curved (for cupola linings) by radii of outside and inside, and the depth.

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PRODUCTION OF ELECTRIC STEEL IN GERMANY

During 1914, there were twenty plants in operation in Germany for producing electric steel. The total output was close to 90,000 tons. About one-half of this amount was produced in furnaces controlled by the firm of Siemens & Halske. Of the twenty plants mentioned, eight are producing high-grade steel of the same class as crucible steel. The output of crucible steel in 1914 was 95,000 tons, or only slightly in excess of the output of electric steel.

DEVELOPMENT OF THE AEROPLANE

One of the results of the European war will be a great increase in the size, weight and capacity of the aeroplane and the bringing of it up to the condition where it may be seriously considered for commercial use. The Curtiss Aeroplane Co., Buffalo, N. Y., which built the *America*, is building hydroaeroplanes of the "Canada" type, having a span of 133 feet, and three planes, each 10 feet wide, and spaced 10 feet apart. It weighs, fully equipped, over 21,000 pounds, and is driven by three twin-six internal combustion engines of 320 horsepower each. There are three propellers, two in front and one in the rear, each having a length of about 15 feet. In addition, this gigantic air craft will have an auxiliary engine of 40 horsepower, which will be used as a starting engine and for driving a screw propeller for propelling the craft when in the water. It is six times larger than any yet tried, and has a cruising radius of nearly 700 miles at a speed of 75 miles an hour. The weight of the hull is 8000 pounds and that of the motors 4000 pounds. It will carry a crew of eight men. Albert Santos Dumont, the famous Brazilian aviator, predicts that in the course of a very few years, giant aeroplanes will be built capable of traveling at the rate of 175 to 250 miles an hour and that regular aeroplane service will be established between the United States and South America. The time required now for the trip from New York to Buenos Ayres is about twenty days, but with the high-speed aeroplane, it will require only about two days.

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DETERMINING INDEXING MOVEMENTS FOR ANGLES

The accompanying tables will be found useful for quickly determining the movements of the indexing crank that are necessary when indexing for angles in minutes and seconds. The tables are used as follows: Reduce the angle to seconds and divide the value thus obtained by 32,400. The quotient gives the number of complete turns and decimal fraction of a turn required. Then find the decimal (or nearest decimal) to this decimal fraction in the tables. Opposite this decimal will be found the fractional number indicating the movement to be made on most of the leading milling machines. The first figure, or the numerator, in this fraction gives the number of holes to be moved, and the second figure, or denominator, the index circle used. As an example, assume that an angle of 10 degrees, 32 minutes, 12 seconds is to be indexed. Then,

$$10 \text{ deg. } 32 \text{ min. } 12 \text{ sec.} = 37{,}932 \text{ seconds.}$$

$$\frac{37{,}932}{32{,}400} = 1.1707$$

From this, it will be seen that this indexing can be made by one complete turn and 0.1707 part of a turn. Looking in the table, we find that 0.1707 part of a turn may be made on all the milling machines listed by moving seven holes in the forty-one hole circle.

The number of holes in the index circles of the indexing head made by the Brown & Sharpe Mfg. Co., Becker Milling Machine Co., Hendey Machine Co., Kearney & Trecker Co., and the Rockford Milling Machine Co. are the same. The index circles in the index head made by the Cincinnati Milling Machine Co. differ from these; hence, a separate column is given in the table for the "Cincinnati" index head. The R. K. LeBlond Machine Tool Co.'s dividing head has the same index circles as that of the Cincinnati Milling Machine Co., except that the LeBlond index head does not have the 24-, 25-, 28-, and 30-hole circles, but has, instead, 36-, 48-, and 56-hole circles. The movements in the 24- and 28-hole circles of the Cincinnati index head may be made on the LeBlond index head by taking double the number of holes in the 48-hole and 56-hole circles, respectively. In this way, the table can also be used for practically all movements in the LeBlond milling machines. The index heads of the Garvin Machine Co., the Oesterlein Machine Co., and the Kempsmith Mfg. Co. have special index plates, and the table does not apply to these machines.

TABLE FOR FINDING INDEXING MOVEMENTS FOR ANGLES—I

Movement in Decimal of a Turn	B. & S., Becker, Hendey, K. & T. and Rockford	Cincinnati and LeBlond*	Movement in Decimal of a Turn	B. & S., Becker, Hendey, K. & T. and Rockford	Cincinnati and LeBlond*	Movement in Decimal of a Turn	B. & S., Becker, Hendey, K. & T. and Rockford	Cincinnati and LeBlond*	Movement in Decimal of a Turn	B. & S., Becker, Hendey, K. & T. and Rockford	Cincinnati and LeBlond*	Movement in Decimal of a Turn	B. & S., Becker, Hendey, K. & T. and Rockford	Cincinnati and LeBlond*	Movement in Decimal of a Turn	B. & S., Becker, Hendey, K. & T. and Rockford	Cincinnati and LeBlond*
0.0152	...	1/66	0.0930	4/43	4/43	0.1739	4/23	8/46	0.2564	10/39	10/39	0.3387	...	21/62	0.4211	8/19	16/38
0.0161	...	1/62	0.0943	...	5/53	0.1754	...	10/57	0.2576	...	17/66	0.3390	...	20/59	0.4211	...	24/57
0.0169	...	1/59	0.0952	2/21	4/42	0.1765	3/17	6/34	0.2581	8/31	16/62	0.3396	...	18/53	0.4237	...	25/59
0.0172	...	1/58	0.0968	3/31	6/62	0.1765	...	9/51	0.2586	...	15/58	0.3404	16/47	16/47	0.4242	14/33	28/66
0.0175	...	1/57	0.0976	4/41	4/41	0.1774	...	11/62	0.2593	7/27	14/54	0.3415	14/41	14/41	0.4255	20/47	20/47
0.0185	...	1/54	0.0980	...	5/51	0.1786	...	5/28	0.2609	6/23	12/46	0.3421	...	13/38	0.4259	...	23/54
0.0189	...	1/53	0.1000	2/20	3/30	0.1795	7/39	7/39	0.2619	...	11/42	0.3448	10/29	20/58	0.4286	...	12/28
0.0196	...	1/51	0.1017	...	6/59	0.1818	6/33	12/66	0.2632	5/19	10/38	0.3469	17/49	17/49	0.4286	9/21	18/42
0.0204	1/49	1/49	0.1020	5/49	5/49	0.1839	9/49	9/49	0.2632	...	15/57	0.3478	8/23	16/46	0.4286	21/49	21/49
0.0213	1/47	1/47	0.1026	4/39	4/39	0.1842	...	7/38	0.2642	...	14/53	0.3485	...	23/66	0.4310	...	25/58
0.0217	...	1/46	0.1034	3/29	6/58	0.1852	5/27	10/54	0.2647	...	9/34	0.3488	15/43	15/43	0.4314	...	22/51
0.0233	1/43	1/43	0.1053	2/19	4/38	0.1860	8/43	8/43	0.2653	13/49	13/49	0.3500	7/20	...	0.4324	16/37	16/37
0.0238	...	1/42	0.1053	...	6/57	0.1864	...	11/59	0.2667	4/15	8/30	0.3509	...	20/57	0.4333	...	13/30
0.0244	1/41	1/41	0.1061	...	7/66	0.1875	3/16	...	0.2683	11/41	11/41	0.3514	13/37	13/37	0.4340	...	23/53
0.0256	1/39	1/39	0.1064	5/47	5/47	0.1887	...	10/53	0.2703	10/37	10/37	0.3519	...	19/54	0.4348	10/23	20/46
0.0263	...	1/38	0.1071	...	3/28	0.1892	7/37	7/37	0.2712	...	16/59	0.3529	6/17	12/34	0.4355	...	27/62
0.0270	1/37	1/37	0.1081	4/37	4/37	0.1897	...	11/58	0.2727	9/33	18/66	0.3529	...	18/51	0.4359	17/39	17/39
0.0294	...	1/34	0.1087	...	5/46	0.1905	4/21	8/42	0.2742	...	17/62	0.3548	11/31	22/62	0.4375	7/16	...
0.0303	1/33	2/66	0.1111	2/18	...	0.1915	9/47	9/47	0.2745	...	14/51	0.3559	...	21/59	0.4386	...	25/57
0.0323	1/31	2/62	0.1111	3/27	6/54	0.1930	...	11/57	0.2759	8/29	16/58	0.3571	...	10/28	0.4390	18/41	18/41
0.0333	...	1/30	0.1129	...	7/62	0.1935	6/31	12/62	0.2766	13/47	13/47	0.3571	...	15/42	0.4394	...	29/66
0.0338	...	2/59	0.1132	...	6/53	0.1951	8/41	8/41	0.2778	5/18	15/54	0.3585	...	19/53	0.4400	...	11/25
0.0345	1/29	2/58	0.1163	5/43	5/43	0.1957	...	9/46	0.2791	12/43	12/43	0.3590	14/39	14/39	0.4407	...	26/59
0.0351	...	2/57	0.1176	2/17	4/34	0.1961	...	10/51	0.2800	...	7/25	0.3600	...	9/25	0.4412	...	15/34
0.0357	...	1/28	0.1176	...	6/51	0.1970	...	13/66	0.2807	...	16/57	0.3617	17/47	17/47	0.4419	19/43	19/43
0.0370	1/27	2/54	0.1186	...	7/59	0.2000	3/15	5/25	0.2821	11/39	11/39	0.3621	...	21/58	0.4444	8/18	...
0.0377	...	2/53	0.1190	...	5/42	0.2000	4/20	6/30	0.2826	...	13/46	0.3636	12/33	24/66	0.4444	12/27	24/54
0.0392	...	2/51	0.1200	...	3/25	0.2034	...	12/59	0.2830	...	15/53	0.3659	15/41	15/41	0.4468	21/47	21/47
0.0400	...	1/25	0.1207	...	7/58	0.2037	...	11/54	0.2857	...	8/28	0.3667	...	11/30	0.4474	...	17/38
0.0408	2/49	2/49	0.1212	4/33	8/66	0.2041	10/49	10/49	0.2857	14/49	14/49	0.3673	18/49	18/49	0.4483	13/29	26/58
0.0417	...	1/24	0.1220	5/41	5/41	0.2051	8/39	8/39	0.2857	6/21	12/42	0.3684	7/19	14/38	0.4490	22/49	22/49
0.0426	2/47	2/47	0.1224	6/49	6/49	0.2059	...	7/34	0.2879	...	19/66	0.3684	...	21/57	0.4500	9/20	...
0.0435	1/23	2/46	0.1228	...	7/57	0.2069	6/29	12/58	0.2881	...	17/59	0.3696	...	17/46	0.4510	...	23/51
0.0454	...	3/66	0.1250	2/16	3/24	0.2075	...	11/53	0.2895	...	11/38	0.3704	10/27	20/54	0.4516	14/31	28/62
0.0465	2/43	2/43	0.1277	6/47	6/47	0.2083	...	5/24	0.2903	9/31	18/62	0.3710	...	23/62	0.4524	...	19/42
0.0476	1/21	2/42	0.1282	5/39	5/39	0.2093	9/43	9/43	0.2917	...	7/24	0.3721	16/43	16/43	0.4528	...	24/53
0.0484	...	3/62	0.1290	4/31	8/62	0.2097	...	13/62	0.2927	12/41	12/41	0.3725	...	19/51	0.4545	15/33	30/66
0.0488	2/41	2/41	0.1296	...	7/54	0.2105	4/19	8/38	0.2931	...	17/58	0.3729	...	22/59	0.4561	...	26/57
0.0500	1/20	...	0.1304	3/23	6/46	0.2105	...	12/57	0.2941	...	15/51	0.3750	6/16	9/24	0.4565	...	21/46
0.0508	...	3/59	0.1316	...	5/38	0.2121	7/33	14/66	0.2941	5/17	10/34	0.3774	...	20/53	0.4576	...	27/59
0.0513	2/39	2/39	0.1321	...	7/53	0.2128	10/47	10/47	0.2963	8/27	16/54	0.3784	14/37	14/37	0.4583	...	11/24
0.0517	...	3/58	0.1333	2/15	4/30	0.2143	...	6/28	0.2973	11/37	11/37	0.3788	...	25/66	0.4595	17/37	17/37
0.0526	1/19	2/38	0.1351	5/37	5/37	0.2143	...	9/42	0.2979	14/47	14/47	0.3793	11/29	22/58	0.4615	18/39	18/39
0.0526	...	3/57	0.1356	...	8/59	0.2157	...	11/51	0.2982	...	17/57	0.3810	8/21	16/42	0.4630	...	25/54
0.0541	2/37	2/37	0.1364	...	9/66	0.2162	8/37	8/37	0.3000	6/20	9/30	0.3824	...	13/34	0.4634	19/41	19/41
0.0556	1/18	3/54	0.1372	...	7/51	0.2174	5/23	10/46	0.3019	...	16/53	0.3830	18/47	18/47	0.4643	...	13/28
0.0566	...	3/53	0.1379	4/29	8/58	0.2195	9/41	9/41	0.3023	13/43	13/43	0.3846	15/39	15/39	0.4651	20/43	20/43
0.0588	1/17	2/34	0.1395	6/43	6/43	0.2203	...	13/59	0.3030	10/33	20/66	0.3860	...	22/57	0.4655	...	27/58
0.0588	...	3/51	0.1404	...	8/57	0.2222	4/18	...	0.3043	7/23	14/46	0.3871	12/31	24/62	0.4667	7/15	14/30
0.0606	2/33	4/66	0.1429	...	4/28	0.2222	6/27	12/54	0.3051	...	18/59	0.3878	19/49	19/49	0.4677	...	29/62
0.0612	3/49	3/49	0.1429	3/21	6/42	0.2241	...	13/58	0.3061	15/49	15/49	0.3889	7/18	21/54	0.4681	22/47	22/47
0.0625	1/16	...	0.1429	7/49	7/49	0.2245	11/49	11/49	0.3065	...	19/62	0.3898	...	23/59	0.4694	23/49	23/49
0.0638	3/47	3/47	0.1452	...	9/62	0.2258	7/31	14/62	0.3077	12/39	12/39	0.3902	16/41	16/41	0.4697	...	31/66
0.0645	2/31	4/62	0.1463	6/41	6/41	0.2264	...	12/53	0.3095	...	13/42	0.3913	9/23	18/46	0.4706	8/17	16/34
0.0652	...	3/46	0.1471	...	5/34	0.2273	...	15/66	0.3103	9/29	18/58	0.3922	...	20/51	0.4706	...	24/51
0.0667	...	2/30	0.1481	4/27	8/54	0.2281	...	13/57	0.3125	5/16	...	0.3929	...	11/28	0.4717	...	25/53
0.0678	...	4/59	0.1489	7/47	7/47	0.2308	9/39	9/39	0.3137	...	16/51	0.3939	13/33	26/66	0.4737	9/19	27/57
0.0690	2/29	4/58	0.1500	3/20	...	0.2326	10/43	10/43	0.3148	...	17/54	0.3947	...	15/38	0.4746	...	28/59
0.0698	3/43	3/43	0.1509	...	8/53	0.2333	...	7/30	0.3158	6/19	12/38	0.3953	17/43	17/43	0.4762	10/21	20/42
0.0702	...	4/57	0.1515	5/33	10/66	0.2340	11/47	11/47	0.3158	...	18/57	0.3962	...	21/53	0.4783	11/23	22/46
0.0714	...	2/28	0.1522	...	7/46	0.2353	4/17	8/34	0.3171	13/41	13/41	0.3966	...	23/58	0.4800	...	12/25
0.0714	...	3/42	0.1525	...	9/59	0.2353	...	12/51	0.3182	...	21/66	0.4000	6/15	10/25	0.4814	...	26/54
0.0732	3/41	3/41	0.1538	6/39	6/39	0.2368	...	9/38	0.3191	15/47	15/47	0.4000	8/20	12/30	0.4815	13/27	...
0.0741	2/27	4/54	0.1552	...	9/58	0.2373	...	14/59	0.3200	...	8/25	0.4032	...	25/62	0.4828	14/29	28/58
0.0755	...	4/53	0.1569	...	8/51	0.2381	5/21	10/42	0.3208	...	17/53	0.4035	...	23/57	0.4839	15/31	30/62
0.0758	...	5/66	0.1579	3/19	6/38	0.2391	...	11/46	0.3214	...	9/28	0.4043	19/47	19/47	0.4848	16/33	32/66
0.0769	3/39	3/39	0.1579	...	9/57	0.2400	...	6/25	0.3220	...	19/59	0.4048	...	17/42	0.4865	18/37	18/37
0.0784	...	4/51	0.1600	...	4/25	0.2407	...	13/54	0.3226	10/31	20/62	0.4054	15/37	15/37	0.4872	19/39	19/39
0.0789	...	3/38	0.1613	5/31	10/62	0.2414	7/29	14/58	0.3235	...	11/34	0.4068	...	24/59	0.4878	20/41	20/41
0.0800	...	2/25	0.1622	6/37	6/37	0.2419	...	15/62	0.3243	12/37	12/37	0.4074	11/27	22/54	0.4884	21/43	21/43
0.0806	...	5/62	0.1628	7/43	7/43	0.2424	8/33	16/66	0.3256	14/43	14/43	0.4082	20/49	20/49	0.4894	23/47	23/47
0.0811	3/37	3/37	0.1633	8/49	8/49	0.2432	9/37	9/37	0.3261	...	15/46	0.4091	...	27/66	0.4898	24/49	24/49
0.0816	4/49	4/49	0.1667	3/18	11/66	0.2439	10/41	10/41	0.3265	16/49	16/49	0.4103	16/39	16/39	0.4902	...	25/51
0.0833	...	2/24	0.1667	...	9/54	0.2449	12/49	12/49	0.3276	...	19/58	0.4118	7/17	14/34	0.4906	...	26/53
0.0847	...	5/59	0.1667	...	7/42	0.2453	...	13/53	0.3333	6/18	8/24	0.4118	...	21/51	0.4912	...	28/57
0.0851	4/47	4/47	0.1667	...	5/30	0.2456	...	14/57	0.3333	5/15	10/30	0.4130	...	19/46	0.4915	...	29/59
0.0862	...	5/58	0.1667	...	4/24	0.2500	4/16	6/24	0.3333	13/39	13/39	0.4138	12/29	24/58	0.5000	8/16	12/24
0.0870	2/23	4/46	0.1695	...	10/59	0.2500	5/20	7/28	0.3333	7/21	14/42	0.4146	17/41	17/41	0.5000	9/18	14/28
0.0877	...	5/57	0.1698	...	9/53	0.2542	...	15/59	0.3333	...	17/51	0.4151	...	22/53	0.5000	10/20	15/30
0.0882	...	3/34	0.1702	8/47	8/47	0.2549	...	13/51	0.3333	9/27	18/54	0.4167	...	10/24	0.5000	...	17/34
0.0909	3/33	6/66	0.1707	7/41	7/41	0.2553	12/47	12/47	0.3333	...	19/57	0.4186	18/43	18/43	0.5000	...	19/38
0.0926	...	5/54	0.1724	5/29	10/58	0.2558	11/43	11/43	0.3333	11/33	22/66	0.4194	13/31	26/62	0.5000	...	21/42

Machinery

* See article for explanatory matter relating to use of table for the R. K. LeBlond milling machines.

TABLE FOR FINDING INDEXING MOVEMENTS FOR ANGLES—II

Movement in Decimal of a Turn	B. & S., Becker, Hendey, K. & T. and Rockford	Cincinnati and LeBlond*	Movement in Decimal of a Turn	B. & S., Becker, Hendey, K. & T. and Rockford	Cincinnati and LeBlond*	Movement in Decimal of a Turn	B. & S., Becker, Hendey, K. & T. and Rockford	Cincinnati and LeBlond*	Movement in Decimal of a Turn	B. & S., Becker, Hendey, K. & T. and Rockford	Cincinnati and LeBlond*	Movement in Decimal of a Turn	B. & S., Becker, Hendey, K. & T. and Rockford	Cincinnati and LeBlond*	B. & S., Becker, Hendey, K. & T. and Rockford	Movement in Decimal of a Turn	Cincinnati and LeBlond*
0.5000	...	23/46	0.5814	25/43	25/43	0.6667	10/15	20/30	0.7447	35/47	35/47	0.8293	34/41	34/41	0.9090	30/33	60/66
0.5000	...	27/54	0.5833	...	14/24	0.6667	26/39	26/39	0.7451	...	38/51	0.8298	39/47	39/47	0.9118	...	31/34
0.5000	...	29/58	0.5849	...	31/53	0.6667	14/21	28/42	0.7458	...	44/59	0.8302	...	44/53	0.9123	...	52/57
0.5000	...	31/62	0.5854	24/41	24/41	0.6667	...	34/51	0.7500	12/16	18/24	0.8305	...	49/59	0.9130	21/23	42/46
0.5000	...	33/66	0.5862	17/29	34/58	0.6667	18/27	36/54	0.7500	15/20	21/28	0.8333	15/18	20/24	0.9138	...	53/58
0.5085	...	30/59	0.5870	...	27/46	0.6667	...	38/57	0.7544	...	43/57	0.8333	...	25/30	0.9149	43/47	43/47
0.5088	...	29/57	0.5882	10/17	20/34	0.6667	22/33	44/66	0.7547	...	40/53	0.8333	...	35/42	0.9153	...	54/59
0.5094	...	27/53	0.5882	...	30/51	0.6724	...	39/58	0.7551	37/49	37/49	0.8333	...	45/54	0.9167	...	22/24
0.5098	...	26/51	0.5897	23/39	23/39	0.6735	33/49	33/49	0.7561	31/41	31/41	0.8333	...	55/66	0.9184	45/49	45/49
0.5102	25/49	25/49	0.5909	...	39/66	0.6739	...	31/46	0.7568	28/37	28/37	0.8367	41/49	41/49	0.9189	34/37	34/37
0.5106	24/47	24/47	0.5918	29/49	29/49	0.6744	29/43	29/43	0.7576	25/33	50/66	0.8372	36/43	36/43	0.9194	...	57/62
0.5116	22/43	22/43	0.5926	16/27	32/54	0.6757	25/37	25/37	0.7581	...	47/62	0.8378	31/37	31/37	0.9200	...	23/25
0.5122	21/41	21/41	0.5932	...	35/59	0.6765	...	23/34	0.7586	22/29	44/58	0.8387	26/31	52/62	0.9211	...	35/38
0.5128	20/39	20/39	0.5946	22/37	22/37	0.6774	21/31	42/62	0.7593	...	41/54	0.8400	...	21/25	0.9216	...	47/51
0.5135	19/37	19/37	0.5952	...	25/42	0.6780	...	40/59	0.7600	...	19/25	0.8421	...	32/38	0.9231	36/39	36/39
0.5152	17/33	34/66	0.5957	28/47	28/47	0.6786	...	19/28	0.7609	...	35/46	0.8421	16/19	48/57	0.9242	...	61/66
0.5161	16/31	32/62	0.5965	...	34/57	0.6792	...	36/53	0.7619	16/21	32/42	0.8431	...	43/51	0.9245	...	49/53
0.5172	15/29	30/58	0.5968	...	37/62	0.6800	...	17/25	0.7627	...	45/59	0.8448	...	49/58	0.9259	25/27	50/54
0.5185	14/27	28/54	0.6000	9/15	15/25	0.6809	32/47	32/47	0.7632	...	29/38	0.8462	33/39	33/39	0.9268	38/41	38/41
0.5200	...	13/25	0.6000	12/20	18/30	0.6818	...	45/66	0.7647	13/17	26/34	0.8475	...	50/59	0.9286	...	26/28
0.5217	12/23	24/46	0.6034	...	35/58	0.6829	28/41	28/41	0.7647	...	39/51	0.8478	...	39/46	0.9286	...	39/42
0.5238	11/21	22/42	0.6038	...	32/53	0.6842	13/19	26/38	0.7660	36/47	36/47	0.8485	28/33	56/66	0.9298	...	53/57
0.5254	...	31/59	0.6047	26/43	26/43	0.6842	...	39/57	0.7667	...	23/30	0.8491	...	45/53	0.9302	40/43	40/43
0.5263	10/19	20/38	0.6053	...	23/38	0.6852	...	37/54	0.7674	33/43	33/43	0.8500	17/20	...	0.9310	27/29	54/58
0.5263	...	30/57	0.6061	20/33	40/66	0.6863	...	35/51	0.7692	30/39	30/39	0.8511	40/47	40/47	0.9322	...	55/59
0.5283	...	28/53	0.6071	...	17/28	0.6875	11/16	...	0.7719	...	44/57	0.8519	23/27	46/54	0.9333	14/15	28/30
0.5294	9/17	18/34	0.6078	...	31/51	0.6897	20/29	40/58	0.7727	...	51/66	0.8529	...	29/34	0.9348	...	43/46
0.5294	...	27/51	0.6087	14/23	28/46	0.6905	...	29/42	0.7736	...	41/53	0.8537	35/41	35/41	0.9355	29/31	58/62
0.5303	...	35/66	0.6098	25/41	25/41	0.6923	27/39	27/39	0.7742	24/31	48/62	0.8548	...	53/62	0.9362	44/47	44/47
0.5306	26/49	26/49	0.6102	...	36/59	0.6935	...	43/62	0.7755	38/49	38/49	0.8571	...	24/28	0.9375	15/16	...
0.5319	25/47	25/47	0.6111	11/18	33/54	0.6939	34/49	34/49	0.7759	...	45/58	0.8571	18/21	36/42	0.9388	46/49	46/49
0.5323	...	33/62	0.6122	30/49	30/49	0.6949	...	41/59	0.7778	14/18	...	0.8571	42/49	42/49	0.9394	31/33	62/66
0.5333	8/15	16/30	0.6129	19/31	38/62	0.6957	16/23	32/46	0.7778	21/27	42/54	0.8596	...	49/57	0.9412	16/17	32/34
0.5345	...	31/58	0.6140	...	35/57	0.6970	23/33	46/66	0.7797	...	46/59	0.8605	37/43	37/43	0.9412	...	48/51
0.5349	23/43	23/43	0.6154	24/39	24/39	0.6977	30/43	30/43	0.7805	32/41	32/41	0.8621	25/29	50/58	0.9434	...	50/53
0.5357	...	15/28	0.6170	29/47	29/47	0.6981	...	37/53	0.7826	18/23	36/46	0.8627	...	44/51	0.9444	17/18	51/54
0.5366	22/41	22/41	0.6176	...	21/34	0.7000	14/20	21/30	0.7838	29/37	29/37	0.8636	...	57/66	0.9459	35/37	35/37
0.5370	...	29/54	0.6190	13/21	26/42	0.7018	...	40/57	0.7843	...	40/51	0.8644	...	51/59	0.9474	18/19	36/38
0.5385	21/39	21/39	0.6207	18/29	36/58	0.7021	33/47	33/47	0.7857	...	22/28	0.8649	32/37	32/37	0.9474	...	54/57
0.5405	20/37	20/37	0.6212	...	41/66	0.7027	26/37	26/37	0.7857	...	33/42	0.8667	13/15	26/30	0.9483	...	55/58
0.5417	...	13/24	0.6216	23/37	23/37	0.7037	19/27	38/54	0.7872	37/47	37/47	0.8679	...	46/53	0.9487	37/39	37/39
0.5424	...	32/59	0.6226	...	33/53	0.7059	12/17	24/34	0.7879	26/33	52/66	0.8684	...	33/38	0.9492	...	56/59
0.5435	...	25/46	0.6250	10/16	15/24	0.7059	...	36/51	0.7895	15/19	30/38	0.8696	20/23	40/46	0.9500	19/20	...
0.5439	...	31/57	0.6271	...	37/59	0.7069	...	41/58	0.7895	...	45/57	0.8704	...	47/54	0.9512	39/41	39/41
0.5455	18/33	36/66	0.6275	...	32/51	0.7073	29/41	29/41	0.7903	...	49/62	0.8710	27/31	54/62	0.9516	...	59/62
0.5472	...	29/53	0.6279	27/43	27/43	0.7083	...	17/24	0.7907	34/43	34/43	0.8718	34/39	34/39	0.9524	20/21	40/42
0.5476	...	23/42	0.6290	...	39/62	0.7097	22/31	44/62	0.7917	...	19/24	0.8723	41/47	41/47	0.9535	41/43	41/43
0.5484	17/31	34/62	0.6296	17/27	34/54	0.7105	...	27/38	0.7925	...	42/53	0.8750	14/16	21/24	0.9545	...	63/66
0.5490	...	28/51	0.6304	...	29/46	0.7119	...	42/59	0.7931	23/29	46/58	0.8772	...	50/57	0.9565	22/23	44/46
0.5500	11/20	...	0.6316	12/19	24/38	0.7121	...	47/66	0.7941	...	27/34	0.8776	43/49	43/49	0.9574	45/47	45/47
0.5510	27/49	27/49	0.6316	...	36/57	0.7143	...	20/28	0.7949	31/39	31/39	0.8780	36/41	36/41	0.9583	...	23/24
0.5517	16/29	32/58	0.6327	31/49	31/49	0.7143	15/21	30/42	0.7959	39/49	39/49	0.8788	29/33	58/66	0.9592	47/49	47/49
0.5526	...	21/38	0.6333	...	19/30	0.7143	35/49	35/49	0.7963	...	43/54	0.8793	...	51/58	0.9600	...	24/25
0.5532	26/47	26/47	0.6341	26/41	26/41	0.7170	...	38/53	0.7966	...	47/59	0.8800	...	22/25	0.9608	...	49/51
0.5556	10/18	...	0.6364	21/33	42/66	0.7174	...	33/46	0.8000	16/20	20/25	0.8810	...	37/42	0.9623	...	51/53
0.5556	15/27	30/54	0.6379	...	37/58	0.7179	28/39	28/39	0.8000	12/15	24/30	0.8814	...	52/59	0.9630	26/27	52/54
0.5581	24/43	24/43	0.6383	30/47	30/47	0.7193	...	41/57	0.8030	...	53/66	0.8824	15/17	30/34	0.9643	...	27/28
0.5588	...	19/34	0.6400	...	16/25	0.7200	...	18/25	0.8039	...	41/51	0.8824	...	45/51	0.9649	...	55/57
0.5593	...	33/59	0.6410	25/39	25/39	0.7209	31/43	31/43	0.8043	...	37/46	0.8837	38/43	38/43	0.9655	28/29	56/58
0.5600	...	14/25	0.6415	...	34/53	0.7222	13/18	39/54	0.8049	33/41	33/41	0.8868	...	47/53	0.9661	...	57/59
0.5606	...	37/66	0.6429	...	18/28	0.7234	34/47	34/47	0.8065	25/31	50/62	0.8871	...	55/62	0.9667	...	29/30
0.5610	23/41	23/41	0.6429	...	27/42	0.7241	21/29	42/58	0.8070	...	46/57	0.8889	16/18	...	0.9677	30/31	60/62
0.5614	...	32/57	0.6441	...	38/59	0.7255	...	37/51	0.8085	38/47	38/47	0.8889	24/27	48/54	0.9697	32/33	64/66
0.5625	9/16	...	0.6452	20/31	40/62	0.7258	...	45/62	0.8095	17/21	34/42	0.8913	...	41/46	0.9706	...	33/34
0.5641	22/39	22/39	0.6471	11/17	22/34	0.7273	24/33	48/66	0.8103	...	47/58	0.8919	33/37	33/37	0.9730	36/37	36/37
0.5645	...	35/62	0.6471	...	33/51	0.7288	...	43/59	0.8108	30/37	30/37	0.8929	...	25/28	0.9737	...	37/38
0.5652	13/23	26/46	0.6481	...	35/54	0.7297	27/37	27/37	0.8113	...	43/53	0.8936	42/47	42/47	0.9744	38/39	38/39
0.5660	...	30/53	0.6486	24/37	24/37	0.7317	30/41	30/41	0.8125	13/16	...	0.8939	...	59/66	0.9756	40/41	40/41
0.5667	...	17/30	0.6491	...	37/57	0.7333	11/15	22/30	0.8136	...	48/59	0.8947	17/19	34/38	0.9762	...	41/42
0.5676	21/37	21/37	0.6500	13/20	...	0.7347	36/49	36/49	0.8140	...	35/43	0.8947	...	51/57	0.9767	42/43	42/43
0.5686	...	29/51	0.6512	28/43	28/43	0.7353	...	25/34	0.8148	...	44/54	0.8966	26/29	52/58	0.9783	...	45/46
0.5690	...	33/58	0.6515	...	43/66	0.7358	...	39/53	0.8158	...	31/38	0.8974	35/39	35/39	0.9787	46/47	46/47
0.5714	...	16/28	0.6522	15/23	30/46	0.7368	14/19	28/38	0.8163	40/49	40/49	0.8980	44/49	44/49	0.9796	48/49	48/49
0.5714	12/21	24/42	0.6531	32/49	32/49	0.7368	...	42/57	0.8182	27/33	54/66	0.8983	...	53/59	0.9804	...	50/51
0.5714	28/49	28/49	0.6552	19/29	38/58	0.7381	...	31/42	0.8205	32/39	32/39	0.9000	18/20	27/30	0.9811	...	52/53
0.5741	...	31/54	0.6579	...	25/38	0.7391	17/23	34/46	0.8214	...	23/28	0.9020	...	46/51	0.9815	...	53/54
0.5745	27/47	27/47	0.6585	27/41	27/41	0.7407	20/27	40/54	0.8226	...	51/62	0.9024	37/41	37/41	0.9825	...	56/57
0.5758	19/33	38/66	0.6596	31/47	31/47	0.7414	...	43/58	0.8235	14/17	28/34	0.9032	28/31	56/62	0.9828	...	57/58
0.5763	...	34/59	0.6604	...	35/53	0.7419	23/31	46/62	0.8235	...	42/51	0.9048	19/21	38/42	0.9831	...	58/59
0.5789	11/19	22/38	0.6610	...	39/59	0.7424	...	49/66	0.8246	...	47/57	0.9057	...	48/53	0.9839	...	61/62
0.5789	...	33/57	0.6613	...	41/62	0.7436	29/39	29/39	0.8261	19/23	38/46	0.9070	39/43	39/43	0.9848	...	65/66
0.5806	18/31	36/62	0.6667	12/18	16/24	0.7442	32/43	32/43	0.8276	24/29	48/58	0.9074	...	49/54	....		

Machinery

* See article for explanatory matter relating to use of table for the R. K. LeBlond milling machines.

SOME PUNCH AND DIE TROUBLES*

REMEDIES THAT HAVE PROVED EFFECTIVE FOR COMMON PUNCH AND DIE TROUBLES

BY JOSEPH M. STABEL†

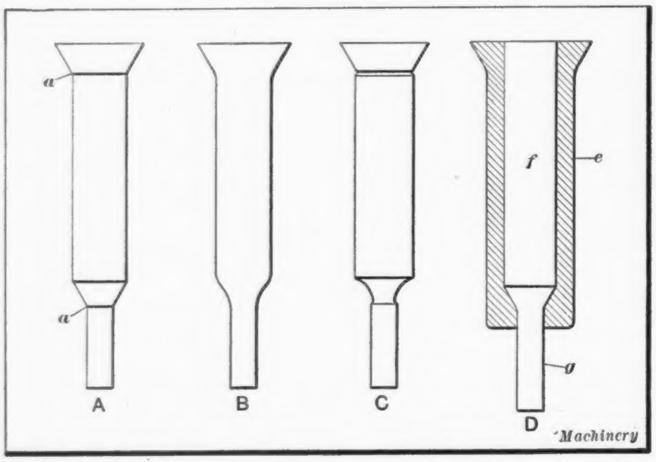


Fig. 1. Methods of making Perforating Punches

We all profit by experience, especially if time is taken to go to the root of any trouble in order to determine its cause. There are many, however, who do not take the time. For instance, if a punch breaks, it is simply regarded as a matter of course and another one substituted. The same punch may be replaced a dozen times without an attempt being made to discover *why* it breaks. As some of the most valuable information is that which has been acquired by noting defects and causes in actual practice, the writer will endeavor to explain a few of the many troubles which he has encountered in connection with different classes of die work, and suggest remedies which experience has proved to be effective.

Punch Troubles and Remedies

Small perforating punches which have annular marks left on them from turning or polishing are much more likely to fracture than those having marks which run parallel with the punch, especially when perforating heavy stock. This is due to the fact that the metal presses into the minute lines or grooves, thus increasing considerably the force required for stripping. As is generally known, most punches when used on heavy metal are broken while stripping the stock and not while perforating it; therefore, the stripping should be made as easy as possible. Another way to reduce the friction when stripping is by making the hole in the die larger than the punch, thus causing a tapering hole to be pierced in the stock. The stripping can also be facilitated by making the punch slightly tapering toward the top, although this is not practicable for small punches, because the strength would be reduced too much.

When the face of a punch which is used on heavy metal tends to chip off, it is caused either by the punch being too hard or the diameter of the die hole being too near the diameter of the punch. If the stripper plate is not parallel with the die, this will also cause broken punches. Even though the error in alignment is small, the constant bending action that the punches must undergo every time the stock is stripped tends to shorten their life. A spring stripper should also be held parallel to the die face. Sometimes the stripping is much harder on one end of the die than on the other, because more holes are perforated at one end. In such cases, special care should be taken to see that the stripper plate starts the stock from the punches evenly and uniformly.

The making of small perforating punches requires attention to minute details in order to secure the best results. For instance, the punch *A*, Fig. 1, has sharp corners, as shown at *a*. A punch should not be made in this way, but rather as shown at *B* with rounded corners. It should never be undercut, as indicated at *C*, because even if it is scored very slightly this will establish a breaking point. It is also a mistake to make small punches longer than is necessary, because it is difficult to temper them properly thoughout their length. When long perforating punches are necessary, as in compound dies, the arrangement shown at *D* is often resorted to. Part *e* is an auxiliary sleeve which acts as the main body of the punch, whereas *f* is a piece of hardened drill rod, and *g* the punch, which can be replaced at small cost. These small punches *g* are pieces of drill rod that have been upset to form a head while held between the vise jaws.

When a die has a number of large and very small punches, it is often advisable to make the large ones long enough to perforate the stock and just enter the die before the small ones touch the metal, especially if the stock is heavy, because the jar resulting from the action of the large punches may shift the stock slightly, which would tend to break the smaller punches, provided they entered the stock at the same time. This method of varying the lengths of punches has often been used to advantage in dies having a large number of punches, because a certain press could be used which otherwise would have lacked the necessary capacity, inasmuch as the pressure required for punching is distributed somewhat.

When locating punches in the holder, one of the principal points to consider is that the stripping strain should be as equally divided in relation to the punch-holder shank as possible; the surface of the holder which bears against the slide of the press should also be of such a size that the face of the slide will not be injured. Punches often shear themselves because a depression has been worn in the face of the slide and for that reason the holder is not properly supported. Inaccuracy in laying out pilot holes in punches and the use of eccentric pilots in order to make them register properly has also been the cause of much spoiled work. The trouble is that when the punch is sharpened, the pilot has to be removed, and it is often not replaced in the same position; consequently it does not engage properly with the pierced holes in the stock.

It sometimes happens that the blanking punch or certain perforating punches are of such a shape that they tend to incline to one side and cause shearing when passing through the metal, thus injuring the edge of both punch and die. This is caused by the shearing thrust not being equal on all sides, as illustrated by the diagram *A*, Fig. 2. In this case the shearing strain from the two long sides tends to crowd the punch over toward the shorter side, as indicated by arrow *a*. To prevent this trouble the face of the punch should be ground to a slight angle so that it enters the shorter side first; then this side will be backed up by the die to take the thrust when cutting the remaining part of the blank.

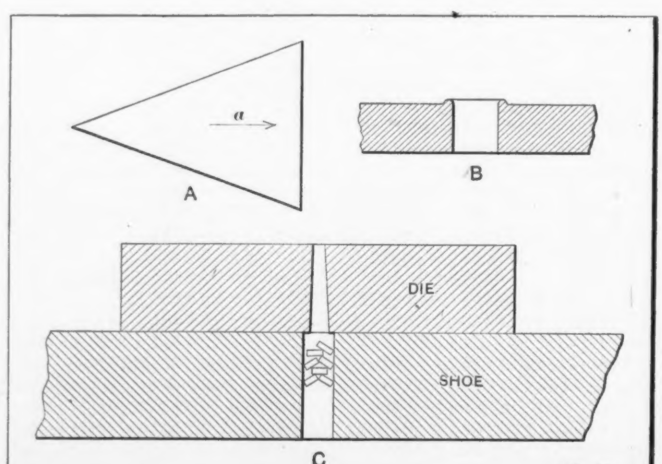


Fig. 2. Diagrams illustrating Troubles connected with Blanking and Piercing Dies

* For additional information on punch and die work, see "Rectangular Drawing and Trimming," September, 1915, and articles there referred to.
† Address: 1653 Main St., Rochester, N. Y.

Location of Stop-pins

When punches are equipped with pilots the stop-pin in the die should be so located that when the pilots enter the pierced holes they will tend to move the stock slightly away from the stop-pin. If the stock were crowded against the stop-pin, a sheared die or a burred hole where the pilot enters would be the result. The location of the stop-pin in a lateral direction should be varied in accordance with the shape of the blank; that is, it is essential to have the stop-pin bear against the stock at such a point that as the stock is fed forward the tendency will be to force it over against the back gage. Fig. 3 illustrates this point. The upper illustration *A* shows the stop-pin in the proper position relative to the back gage, whereas the lower view *B* shows it in such a position that the tendency is to crowd the stock away from the back gage as it is fed forward.

As to the scrap allowance or width of the "bridge" between the blank openings, it is common to allow the thickness of the stock, but this rule should not always be applied. For instance, when narrow strips, 1/4 inch wide by 3 inches long, were blanked out crosswise of the strip, it was found that by allowing only the thickness of the metal the punch sheared off toward the scrap side because the end cuts were so narrow that they did not support the punch against the thrust resulting from the shear on the solid side of the strip. When using dies of the general shape referred to, it is advisable to allow at least 1 1/2 times the thickness of the stock between the blanks.

Clearance—Cause of Slugging

Another trouble often encountered with compound dies, as well as other types, is due to roughness and lack of proper clearance in the die holes, especially if they are small. The surface of a hole should be very smooth and the taper reamer that is used in finishing it should produce a smooth finish free from circular ridges. Some of the first indications of "slugging" (as diemakers term the plugging up of a perforated hole) are as follows: First, the breaking of punches; second, the punches being upset or pushed back so that the hole is not quite punched through; third, the appearance of a burr on the top side of the blank around the hole, as indicated at *B*, Fig. 2. When the punch is of such a temper that it will neither burr nor break but will flatten out the slug before there is pressure enough exerted on the remaining slugs of the die to push them downward, the top slug expands, thus forcing the metal out and forming the burr as shown. Slugging may be caused by too much clearance in the hole through the shoe beneath the die. This may seem strange to many, but it has caused much difficulty when perforating small holes. The diameter of this clearance hole should be such that the slugs cannot clog into it by forming a bridge as indicated at *C*, Fig. 2. If the clearance hole is a little too large, sometimes the oil on the slugs will cause them to stick to the sides of the hole so that they become jammed and form a bridge.

A blank having a burr around the edge is not always a sign that the punch does not fit the die properly. The trouble may be that the die has not the proper amount of clearance, so that forcing a blank through such a die forms a burr. By examining the edge of the blank one can easily tell whether the die clears itself properly or not. Thus, if some parts of the edge are polished or burnished, it indicates that clearance is lacking at these points.

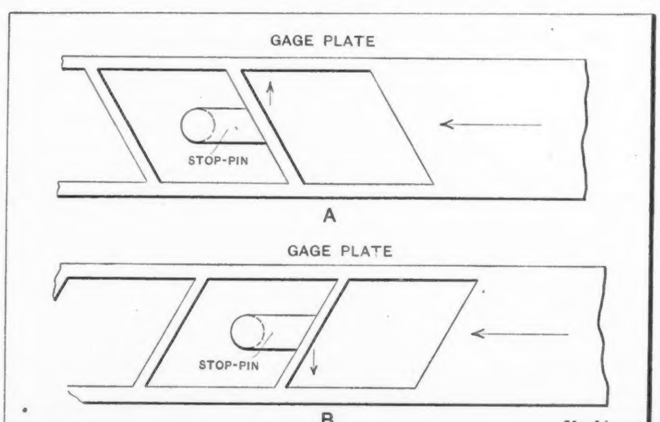


Fig. 3. Correct and Incorrect Methods of locating Stop-pin relative to Gage Plate

Bending and Forming Dies

It is important to know something about the action of metal when it is being bent or formed in different types of

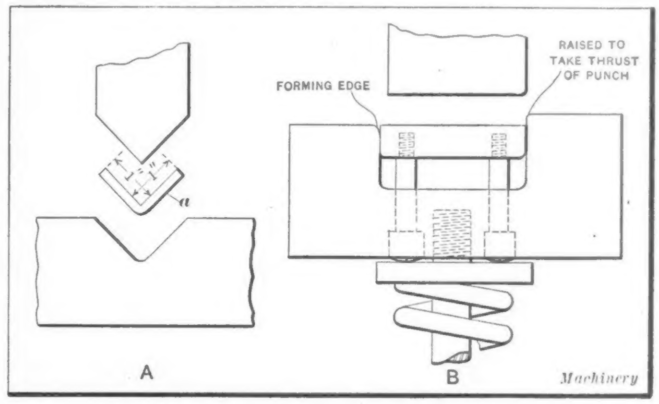


Fig. 4. Two Forms of Bending or Forming Dies

dies. Two distinct classes of bending dies are illustrated in Fig. 4. One is an open die without a pressure pad, whereas the other has a pressure pad to prevent the blank from creeping. The metal has a natural action in the open die, whereas with a pressure pad type the tendency is to draw it, especially if it is squeezed rather hard between the die and punch, which is often necessary in order to form a square shape. When metal is given a right-angle form it shortens up the blank an amount equal to one-half the thickness of the stock. Referring to *A*, Fig. 4, part *a* is 1/8 inch thick and each side has an inside length of 1 inch; hence the blank for this part would have a length equal to 2 inches plus half the thickness of the stock, or 2 1/16 inches. If the blank should have more than one right-angle bend simply multiply the number of such bends by half the thickness of the stock, plus the inside measurement of all the sides, to obtain the total length of the blank.

The radius formed on the outside of any right-angle bend, which has a sharp corner inside, is about 1 1/4 times the thickness of the stock. This radius, however, will vary slightly in accordance with the hardness of the material. When making dies to form metal that is of a hard temper, such as German silver, hard brass or steel, it is advisable to allow the punch to strike harder at the forming point, as this tends to set the metal, thus producing greater uniformity in the pieces formed. A slow acting press will not set a form as well as one with more speed, although a slow action will often form metal that is too hard to be formed in a quick-acting press, without fracturing.

When parts are to be blanked preparatory to bending, it is advisable to make the blanking die so that the grain of the metal in the blank will be at right angles to the bend. When working German silver, or metal of a hard temper, this is important and if ignored there will be a large percentage of loss as the result of fracturing. If the blanking die should be laid out incorrectly as regards the grain, the defect may be remedied by cutting the stock from the sheets so that the grain will run properly in the blank.

Pointers on Drawing Die Construction

Some of the most common causes of trouble in the operation and construction of drawing dies will now be considered. Care should be taken that a shell which is the first of a series of operations, is uniform in height all around, because a little unevenness will multiply as it passes through succeeding dies, thus requiring a larger blank than is necessary. This defect is often caused by the blanking ring not being concentric with the drawing die; the blank-holder may also bear harder on one side than on the other, or a bad burr on one side of the blank may result in holding that side back. If the bottom of the shell breaks out, this may be caused by

using a die that is too small in relation to the blank diameter. The rule usually employed for cylindrical work is that a shell may be drawn to a depth equal to its diameter. Very often this depth may be exceeded somewhat, but the strength of the bottom of the shell will be reduced for succeeding draws. Other causes of fracture at the bottom of the shell are: too small a drawing radius, insufficient clearance between the punch and die, excessive blank-holder pressure, excessive friction between the blank-holder and die caused by grinding marks on either die or blank-holder, and inferior quality of drawing metal.

The straight or cylindrical surface below the curved drawing edge of the die should not be too long because the pressure exerted on the metal when it is being drawn over the rounded edge tends to remove most of the lubrication, thus leaving very little for the straight surface; consequently, a scored shell is likely to be the result if the cylindrical part of the die is too long. The length of this straight part usually varies from 1/4 to 1/2 inch. The diameters of the punch and die should be measured occasionally to determine the width of the clearance space. If, as the result of wear, this clearance becomes excessive, the metal will thicken to such an extent that there will be difficulty in connection with succeeding drawing operations.

Any taper of the punch in an upward direction naturally would make it difficult to strip the drawn part. A vent hole through the center of the punch, opening to the atmosphere at some point above the top of the shell, is also very important, as it prevents the formation of air pockets and facilitates stripping. The punch should always be polished in a lengthwise direction, as this also aids in stripping the work.

When determining the size of the blank for an irregular or rectangular shape, always begin by making the blank a little smaller than what is expected to be the required size. Then if fracturing occurs, it is very evident that a larger blank cannot be used, whereas if the blank is over size a fracture may occur, thus leading to the conclusion that the draw is not practicable, although a proper size blank might be drawn without difficulty. The corners of a rectangular shaped punch and die should be very hard, because most of the wear is in the corners. Care should be taken that the metal does not thicken perceptibly during any one draw if others are to follow, but it is advisable to allow the corners to thicken slightly if there is only one operation or during the final operation of a series.

To draw a cylindrical projection from a hole pierced in a flat blank, the hole should first be reamed out to prevent the lower edge *a*, Fig. 5, from splitting. This splitting at the edge when a hub is drawn without reaming the hole is doubtless due to the compression of the metal by the action of the punch, which causes splitting when the hole is expanded. When this compressed surface, however, is cut away by reaming, the stretching action does not have the same effect.

Effects Produced by Trapped Oil, Air and Water

Forming the piece shown at *A*, Fig. 6, which is made from 1/8-inch sheet brass, requires three operations, the last of which is done with a drop-hammer. After this part is formed, it has to be machined all over. One day a complaint was received that the thickness *x* was below size and that the parts could not be trued up. The stock was measured and also the piece before it went to the drop-hammer and both measurements indicated that it was O. K. Finally, the trouble was located and it was found to be due to the fact that the operator used too much oil in swabbing out the dies. This oil was trapped in the die and when the blow was struck, the pressure was so high as to reduce the original thickness from 0.005 to 0.008 inch. The surface of the metal was also made quite rough. The use of a light coating of oil eliminated the trouble.

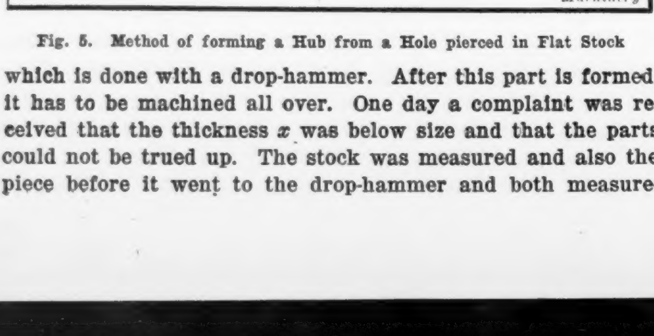


Fig. 5. Method of forming a Hub from a Hole pierced in Flat Stock

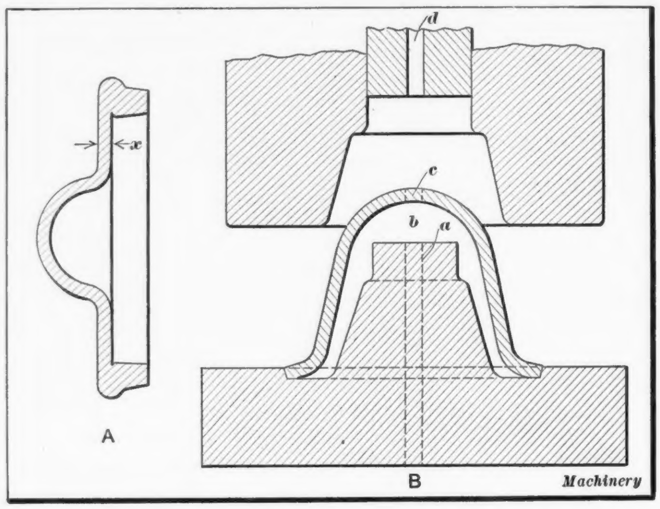


Fig. 6. (A) Part which was unintentionally reduced in Thickness by Oil Pressure; (B) Die which pierced Hole at c by Pressure of Air trapped at b

Another unusual incident happened in connection with a compound blanking and drawing die. This was used in a press having an automatic roll feed and a compressed air pipe extended down from the ceiling. This air was used to blow the drawn cups away from the die into a box back of the press. One night the shut-off cock on the air pipe was not closed completely and water which had condensed in the line dropped onto the die and flowed under the pressure pad, which was entirely housed in. When the press was first tripped the next morning the shoe was pushed through the hole in the bolster plate because the water could not flow out quickly enough.

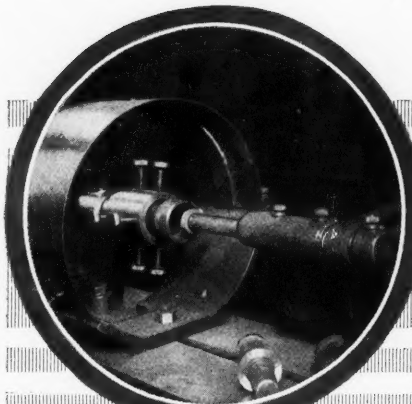
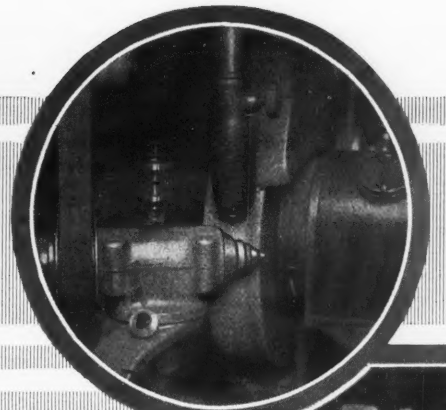
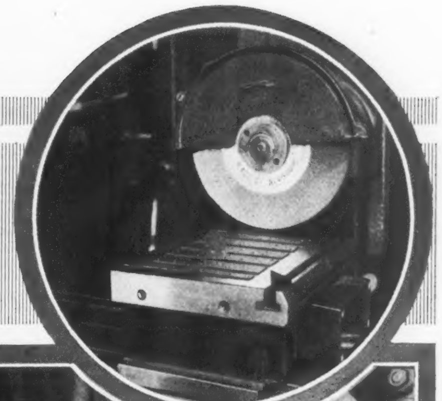
The action of air under high pressure is illustrated by another example. In making the die shown at *B*, Fig. 6, the diemaker failed to drill a vent hole through the punch, as indicated by the dotted lines *a*. The result was that when the press was tripped the air in space *b* was compressed to such a degree that a slug *c* was forced out into vent hole *d* in the knockout. The material was No. 8 brass, B. & S. gage, and a hole was made as neatly as though it had been pierced by a punch. This indicates in a rather striking way how the lack of necessary vent holes increases the load on both the die and press.

* * *

The annual convention of the American Foundrymen's Association and the American Institute of Metals will be held in Cleveland, Ohio, during the week of September 11. The annual exhibition of foundry equipment and supplies to be held concurrently with the meetings of these organizations will be conducted under the auspices of the American Foundrymen's Association and the American Institute of Metals. The exhibition will be held in the Cleveland Coliseum which contains 60,000 square feet of floor space on one level and is admirably adapted for a foundry show. A. O. Backert, 12th and Chestnut Sts., Cleveland, Ohio, is the secretary and treasurer of the association.

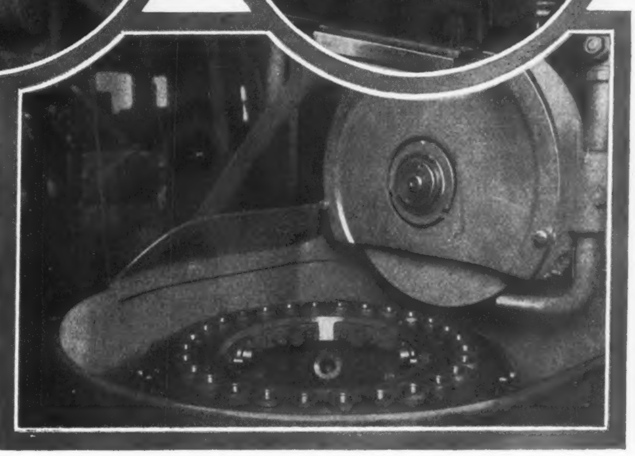
* * *

According to the *Scientific American* there has appeared, in England, a new telephone device which renders possible the summoning of a subscriber back to the telephone after he has been asked to "hold the wire" while the party at the other end is looking up some desired information. The device is in reality a loud-speaking horn. If the subscriber called does not wish to hold the receiver to his ear, he can place it over the horn and go about his duties. The calling party's voice is so amplified that it may be heard throughout a room.

Methods of Holding Work for Grinding

Douglas T. Hamilton



THE correct method of holding work for grinding is governed largely by the character of the work, its shape, and other considerations, such as accuracy, production, etc. The methods that are in use in different plants and on various classes of work are so diversified that it is impossible to describe them all, but in order to make the following article comprehensive a few of the more common ones involving standard principles will be illustrated. Most of the devices shown are those used in connection with the manufacture of automobile parts. These have been chosen first, because of their ease of operation, which is necessary to insure rapid production; and second, because of the accuracy required in this work.

Conditions which Govern the Type of Work-holding Device used for Grinding

In designing a work-holding device for carrying a certain piece of work while grinding, there are a number of points that should receive consideration. In the case of bushings having thin walls, for instance, it is essential that the work be held so that it is not put under tension or subjected to clamping strains; in holding irregular shaped work, other conditions are encountered; while in holding work which has only one end centered, a device for holding the "blind" end must be provided. Crank- and cam-shafts for gas engines present other points in work-holding devices that are worthy of consideration. For the average run of work, the points that must be considered can be summed up as follows:

1. Shape of work, whether hollow, provided with centers, or "blind" on one end.
2. Location of surface to be ground, whether concentric, as in long, plain shafts, or eccentric as in crankshafts.
3. Slenderness of work, such as thin bushings, sleeves, etc.
4. Relation of ground surfaces to previously finished parts.
5. Convenience of operation as regards accessibility for removing or clamping the work.
6. Accuracy and production required. Aside from the character of the work, this last point, on the average run of work, is the most important.

Holding Work on Centers

The common method of holding and driving work while grinding externally, when the work is provided with centers, is shown in Fig. 1. This is used on the plain or universal cylindrical grinding machines, and is well known. The shape of the center is governed by the conditions of the work. *A* in Fig. 2 shows the common plain 60-degree center; *B*, a center cut down to clear the wheel to permit small diameter work to be ground; *C*, another method of reducing the body of the center for holding small work; and *D*, a center for supporting tubing or work having a large hole in the end. The center shown at *E* is known as a female center and is used to support work that has no center but is pointed on the end.

Where the work is provided with a center in one end only and a large hole in the other, like a gas engine piston, the method shown in Fig. 3 can be used. Here a plate *A* is fitted into the hole in the open end of the piston, and a pin *B* passes through rod *D*, fitting the wrist-pin hole. When the wrist-pin hole has been bored and reamed in perfect alignment and at right angles to the axis of the piston, the pin *B* should be a good fit for it, but when this has not been done previous to grinding, it should be a loose fit, as illustrated. The piston is held on the plate *A* by nut *C* that draws the pin *B* against the wrist-pin hole and clamps the piston rigidly. The arbor is driven by a pin *E* that comes in contact with the driving pin held in the faceplate of the grinding machine.

Another method of holding work on centers is shown in Fig. 4. Here the work has a center in one end and a slot in the other, and the requirements are that the axis of the shank and body be ground at right angles to the center of the pin hole. In order to handle this work satisfactorily, a close fitting pin *A* is placed in the hole in the work as indicated. The headstock center *B* is provided with a V-slot to contact with pin *A*, and is slabbed down to fit the slot in the work. It will therefore be seen that this type of center, in addition to holding the work central, also drives it.

Still another method of holding work while grinding externally is shown in Fig. 5. In this case the work is a one-throw crankshaft, and for grinding the crankpin it is necessary to offset the crankshaft, as illustrated. A large variety of fixtures have been devised for handling crankshafts, but this device has been chosen because of its simple construction. In this case it will be noticed that two blocks, held in place by set-screws, are fitted to the ends of the crankshaft. With a plain fixture of this type, it is necessary to line the blocks up properly with the work before clamping, and to do this the bottoms of the blocks are made square so that they can rest on the surface plate; then the crankshaft and blocks

For information on grinding previously published in MACHINERY, see "Grinding Wheel Truing Devices," November, 1915, and articles there referred to.

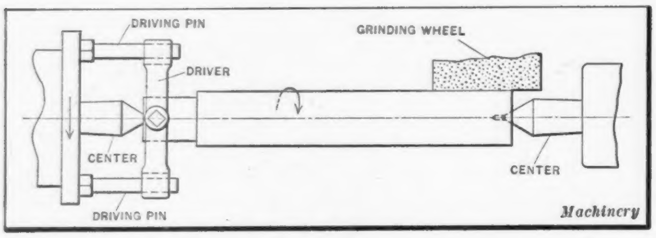


Fig. 1. Common Method of holding and driving Centered Work when grinding externally

are squared up from the surface plate with an ordinary machinist's square, and clamped in position. Other work of an eccentric nature is handled in a similar manner, the type of fixture used, of course, depending on the character of the work and the number of eccentrics or amount of eccentricity.

Holding Work on Solid Mandrels

The class of work held on mandrels is not confined to bushings, but includes any work that can be conveniently held in this manner. The common method of holding work on a mandrel is shown at *A* in Fig. 6, in which the part being ground is an ordinary plain bushing. This should not be used for holding work which has not previously been ground in the holes, because if the hole is not true and straight, it will not bear evenly on the mandrel and when it becomes heated will take the shape of the arbor; then when the work is removed, it will be found to be untrue. Mandrels of this

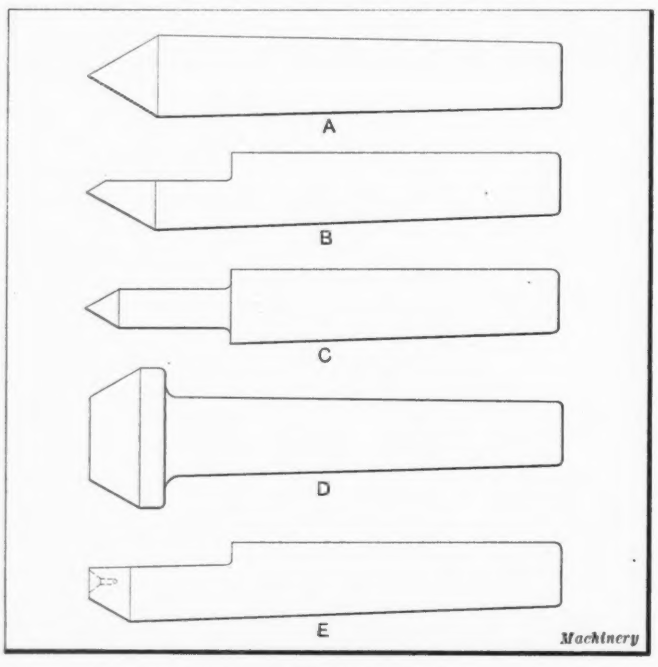


Fig. 2. Collection of Different Shaped Centers for supporting Work in Cylindrical Grinding Machines

type, which in reality are friction mandrels, should never have the work driven tight on them. They should be provided with a very slight taper, about 0.002 to 0.005 inch to the inch. For holding thin-wall bushings, the better practice is to clamp the work from the ends, as will be illustrated and described later. At *B* is shown the common method of holding a tapered bushing; the information given in the foregoing applies also to this case, with the exception that the taper on the mandrel should be the same as the hole in the work.

Another example illustrating the use of solid mandrels for holding work is shown in Fig. 7. This mandrel is used for holding a cream separator bowl shell *F* while grinding the straight and tapered surfaces. As is shown in the illustration, the mandrel consists of a two-diameter sleeve *A* driven into the tapered mandrel *B*. The center flange *C* supports the shell internally, whereas flange *D* supports it externally, the shell being chamfered to catch under a projecting rib on this flange. The work is clamped in place by nut *E*. The rear face of flange *D* is provided with a rib that contacts with the driving pin in the faceplate and serves to drive the work.

Fig. 8 shows a simple and effective mandrel for holding a ball race cup. This, it will be noticed, is a difficult piece to hold. The mandrel consists of a central stud *A* hardened and ground, and threaded to receive the knurled bushing *B*. This is also hardened and ground internally as well as on those points where it contacts with the ball race cup. The work is held in position by adjusting sleeve *B* which forces the cup against split washer *C*. The mandrel is rotated by pin *D*, which is driven through it and comes in contact with the driving pin on the faceplate of the machine.

Spring Bushing Mandrels for Holding Work for Grinding

The grinding of bushings having thin walls presents considerable difficulty especially when hardened, as the hole is us-

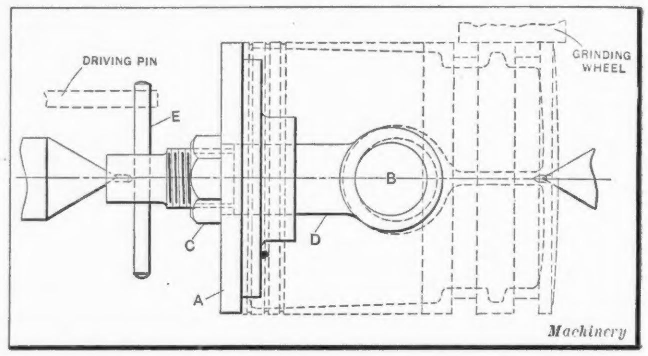


Fig. 3. Method of holding Gas Engine Piston for External Grinding

ually sprung out of round and consequently cannot be depended upon as an accurate point from which to locate for grinding the external diameter. The hollow piston pin shown in Fig. 9 is a good illustration of this point. This piston pin is made from Shelby tubing having a 5/32-inch wall, is carbonized 0.030 inch deep, and hardened. In carbonizing and hardening, the tubing is distorted considerably, and to place it on a solid mandrel to grind the external diameter would mean that it would only bear on the high points, and when the scale was removed would be distorted.

Fig. 9 shows a special mandrel designed for this purpose, which handles the work satisfactorily. It comprises a central mandrel *A*, hardened and ground all over, and carrying two sleeves *B* and *C*, as well as two cone-shaped work supports *D* and *E*, these being backed up by open-wound springs *F* and *G*. It will be noticed that the work is merely located by sleeves *D* and *E* and is clamped from the ends by sleeves *B* and *C* and nut *H*. The method of using this type of mandrel is as follows: Two or three of these mandrels are made up at one time so that while one piece is being ground in the machine, the operator can be loading another, thus making production practically continuous. To insert the work on the mandrel, nut *H* is removed and sleeves *C* and *E* withdrawn. It will be noticed that sleeve *E* carries a pin fitting in a slot in sleeve *C* so that the coil spring cannot force it out when the sleeve is removed from the mandrel. The work is now placed on the mandrel, being centered by the end of the stationary sleeve *D*, as well as pin *I*. Then the sleeves are replaced and the nut tightened sufficiently to hold the work

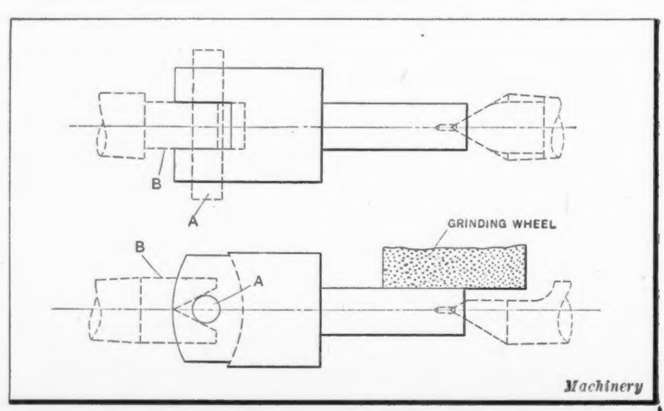


Fig. 4. Method of holding Piece having a Center Hole in One End and a Slot in the Other

rigidly in position. This method of holding the work eliminates strains and insures an accurate job.

In Fig. 10 is shown another "floating" mandrel that differs slightly from that previously described. This mandrel is also made in duplicate or triplicate, and comprises a center bar *A*, hardened and ground, and carrying a bushing cup *B* that is pinned to it. Cup *B* is counterbored to receive the spring-controlled work-holder *C* which is prevented from being forced out by the four coil springs *D*, by means of fillister-head screws *E*. In this case it will be noticed that the flange on one end of the work is of sufficient width to permit of the bushings being squared up by the use of one cone sleeve *C*, the other being simply a face sleeve *F* that holds the bushing tightly up against the bushing cup *B*. The mandrel is also provided with a slotted washer *G* and nut *H*. To remove the work, the

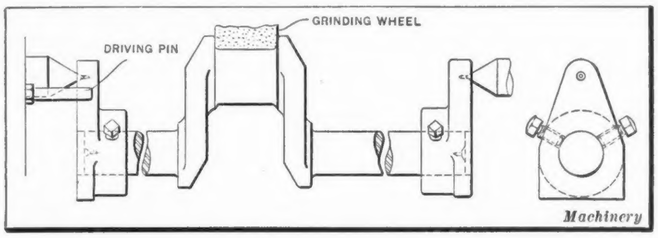


Fig. 5. Method of holding and driving a One-throw Crankshaft when grinding Crankpin

nut *H* is released and washer *G* withdrawn, enabling sleeve *F* to be removed, whereupon the work can be taken off and a rough piece put on.

Expanding Work-holding Mandrel

The holding of a ball bearing race accurately to grind the external diameter is a difficult proposition, and to accomplish this satisfactorily the race should be located from the inner cone or circle that the balls subsequently run in. The expanding mandrel, therefore, is the only satisfactory solution. Fig. 11 shows a special mandrel designed for this purpose that incorporates some interesting features. It comprises a tapered bar *A* carrying three segment work supports *B*, which are prevented from turning on the bar by pins held in them that work in the slots shown. These segments are held together by two "bracelet" coil springs *C* and *D* that completely surround them. To place the work on the mandrel, the three segments are drawn to the smallest end, the work slipped over them, and then the segments are pushed back to the larger diameter, causing them to expand and grip the work.

An important point in connection with this mandrel is the amount of taper given to it. The first mandrel that was tried out had an included taper of 15 degrees—about 3⅛ inches to the foot. When tried it was found impossible to hold the work square with the axis of the mandrel. Because of the steep taper, a slight tilting action was given to the segments, making it impossible to hold the work accurately. The reason for this was that the taper was so steep that a slight difference in the longitudinal position of the segments made a considerable difference in their respective distances

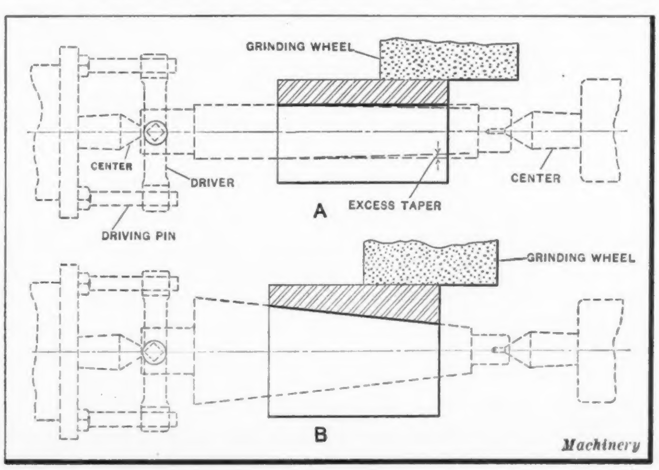


Fig. 6. Holding Straight and Tapered Hole Bushings on Solid Mandrels

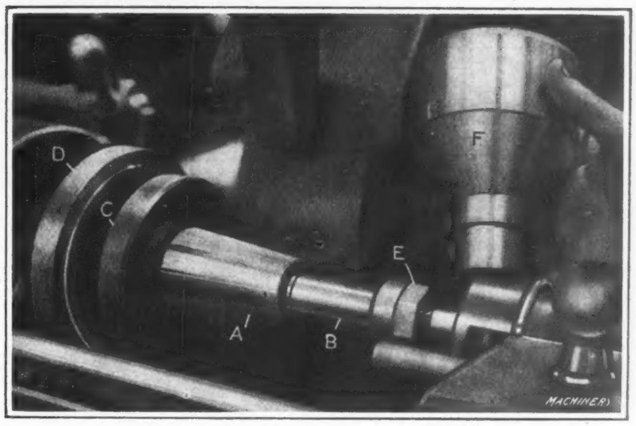


Fig. 7. Method of holding Cream Separator Bowl Shell for grinding External Diameter

from the axis. Another mandrel was made, having a taper of 1½ inch to the foot, and this was found to work satisfactorily. This had sufficient taper to take care of the necessary movement required to expand the segments for gripping the work, and also held the work much more rigidly and accurately.

Mandrel for Holding a Transmission Yoke

The external diameter of the transmission yoke *A* in Fig. 12 presents a difficult grinding proposition. By referring to this illustration, it will be noticed that the front end of the yoke is split or slotted and the rear end has a tapered hole. The requirements are that the external diameter be ground true with the tapered hole. In grinding this yoke, the order of operations is handled somewhat differently from that fol-

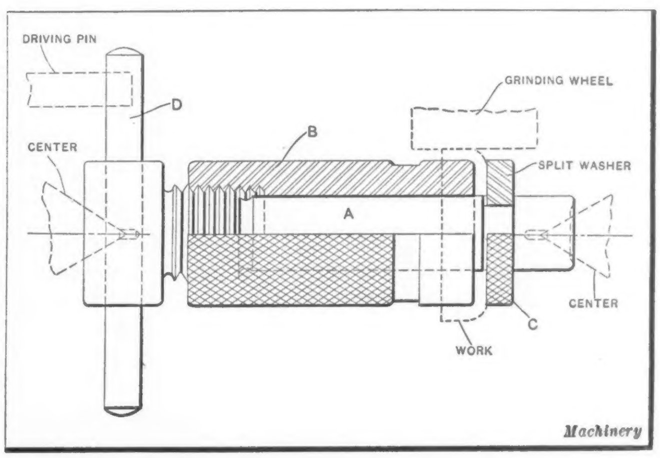


Fig. 8. Special Type of Mandrel for holding Ball Race Cup for grinding External Diameter Concentric with Raceway and Square with Inside Face

lowed in grinding a plain bushing. The bearing surface *a* and tapered hole *b* are previously ground, as will be explained later. This gives two points from which the work can be accurately located for grinding the external diameter. The mandrel used for holding this piece comprises a hardened and ground rod *B*, over which is slipped a flattened bushing *C* ground to fit accurately in the previously ground bearing *a*. The object of this bushing is to prevent the yoke from collapsing. In order to prevent the work from springing outward, a ring *D* is clamped to the end by bolts as shown, fitting in previously tapped holes in the work. This prevents any outward or inward springing of the yoke while it is being ground. The work is held for driving by the tapered portion on the mandrel fitting the tapered hole in the work.

Still another method of holding work for external grinding is shown in Fig. 13. The part *A* being ground is a cone for a fan shaft, and the operation consists in grinding the cone end as shown. The fixture used for this purpose is an old type Landis center grinder, which has been remodeled to fill the requirements. The regular spindle was removed and substituted by a special draw-in spindle *E* operated to hold the work by open-wound spring *B*. The front end of the spindle is slotted and carries a removable split washer. To remove the

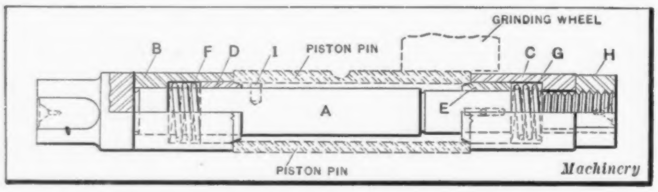


Fig. 9. Spring Bushing Mandrel for holding Piston Pin from End, thus eliminating Clamping Strains

work from the fixture, lever *C*, fulcrumed in special bracket *D*, is forced forward, carrying with it spindle *E* and compressing spring *B*, thus allowing the washer and work to be removed. Previous to the use of the fixture shown in Fig. 13, this cone was held and ground in a special grinding machine fitted up for the purpose, in which production was greatly limited owing to the construction of the machine. This improvised fixture was then used and production was increased from 800 to 1200 pieces in nine hours.

Work-holding Devices for Internal Grinding

The most common method of holding work to be ground internally, especially if the part to be ground is cylindrical in shape, is to grip it in a four- or three-jaw chuck as shown at *A* and *B* in Fig. 14. The jaws of the chuck are sometimes modified to suit the shape of the work and are generally ground to get the required accuracy after the chuck is placed on the machine spindle. The four-jaw chuck is not as frequently used as the three-jaw chuck, because three points of support,

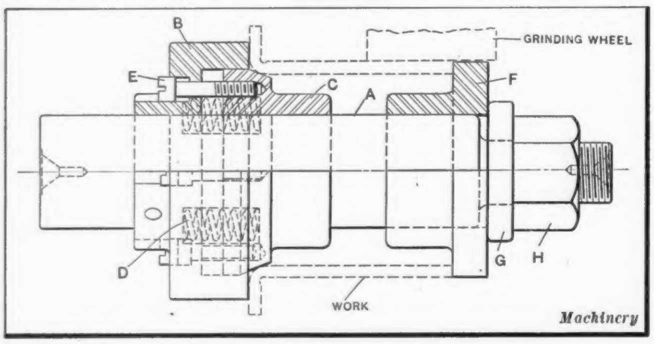


Fig. 10. Another Spring-controlled Bushing Mandrel

especially on work with a rough surface, are better than four. For holding thin-wall bushings, the ordinary chuck is not recommended because of the liability of springing the work out of shape in clamping.

For holding comparatively small work, the draw-in type of collet shown at *C* in Fig. 14, is used. This is limited to a certain extent to the holding of plain work. With slight modifications, however, it can be adapted for holding segment removable clamping jaws as shown in Fig. 25. *D* in Fig. 14 shows another method of holding work of the bushing type. This is an air chuck operating on the well-known principle common to this type of holding device. The jaws *a* of this chuck are operated through levers *b*, receiving the necessary movement from the plunger *c* that communicates with the air cylinder. Jaws *a* can be adjusted independently by screws *d* to cover a considerable range of diameters. Air chucks can be used with success on work that is of comparatively plain outline and stiff enough to stand the necessary clamping pressure without being sprung out of shape. One advantage of the air chuck over other mechanical gripping devices is that the pressure is constant.

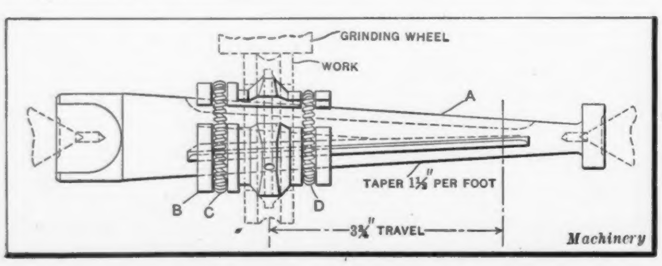


Fig. 11. Special Taper Expanding Mandrel for holding Outer Ball Race when grinding External Diameter

As previously mentioned, it is a difficult matter to hold hardened bushings without springing them out of shape. The reason for this is that the work, when hardened, is distorted to a greater or less extent, and when put on an ordinary mandrel or held in the chuck in the rough condition, there is only point contact, which causes distortion as soon as the hardening scale is removed. The practice sometimes followed is to grind the hole first and then place the bushing on a solid mandrel to grind the external diameter. This practice, as previously mentioned, is not recommended when the bushing

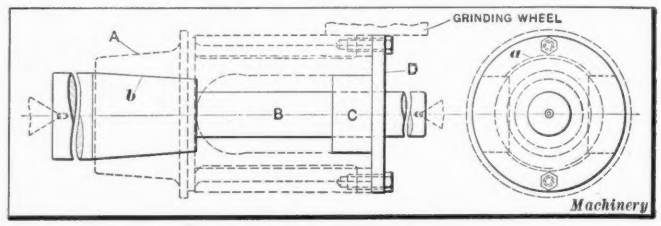


Fig. 12. Method of solving Difficult Holding Proposition

has thin walls. A better way is to grind the external diameter of the work first, using a mandrel of the types shown in Figs. 9 and 10, and then grip the work for grinding the internal diameter in a device of the type shown in Figs. 15 and 16. Referring to Fig. 15, as was previously mentioned, the external diameter of bushing *A* is ground first, then the bushing is slipped into a close fitting chuck *B*. The body of chuck *B* is fastened to the faceplate *C*, which is screwed onto the nose of the internal grinding machine spindle. The other members of the fixture consist of toe-clamps *D*, draw-bar *E* and yoke *F*. Draw-bar *E* passes completely through the machine spindle, and being attached to yoke *F* operates the toe-clamps *D* that hold the work in place against the resistance of the grinding wheel. It will be noticed that, in this type of fixture, none of the parts extend so as to interfere with its operation or cause accidents. In order to remove or replace the work in the fixture, the draw-bar is released, then the toe-clamps are swung away from the stop-pins *G*, the finished work re-

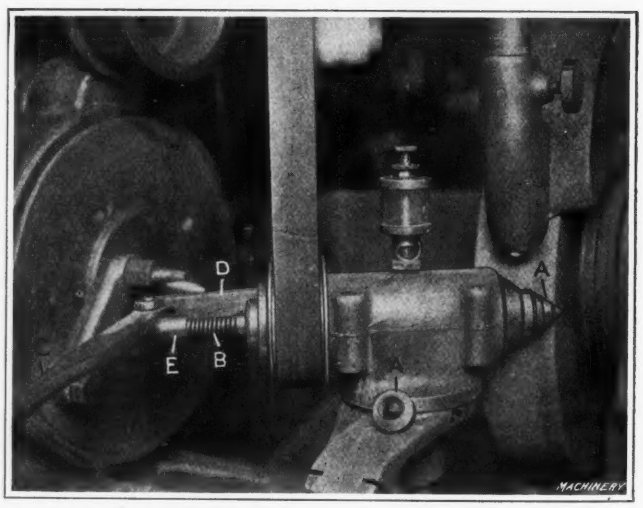


Fig. 13. Improvised Fixture used in holding Cone for grinding, that greatly increased Production over Former Method

moved, and a rough piece inserted, after which the toe-clamps are swung back to the stop-pins and the draw-bar tightened.

Fixture for Holding Drive-shaft Yoke

The drive-shaft yoke shown in Fig. 16 is another example of work that is difficult to hold without distortion. The large external diameter of yoke *A* has previously been ground in a manner similar to that shown in Fig. 12, and for grinding the internal diameter it is held in a close fitting chuck without putting any pressure on the external diameter. The fixture, as shown in Fig. 16, consists of casting *B* screwed onto the nose of the machine spindle, and carrying two toe-clamps *C* tied together by yoke *D* and operated by draw-in bolt *E* that passes through the spindle of the machine. In order to protect the workman, brass guard *F* is fitted over the fixture so

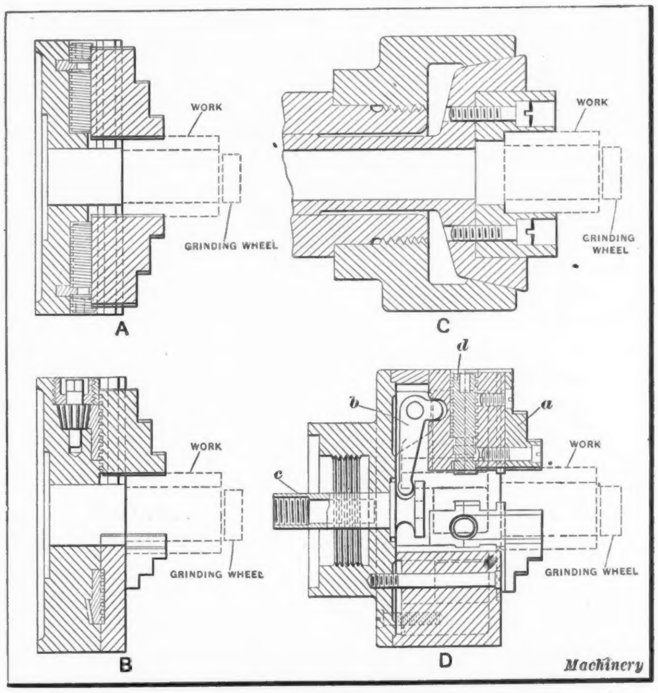


Fig. 14. Diagram showing Various Standard Devices for holding Work for Internal Grinding

that the nuts on the ends of the toe-clamps are not exposed. The forward end of this fixture is ground in perfect alignment with the machine spindle, and is a good fit for the external ground surface of the work. With this type of fixture it is possible to hold the work rigidly without subjecting it to excessive clamping strains.

Holding Work for Internal and External Grinding

Fig. 17 shows a special type of fixture used on a Bryant chucking grinder for holding a transmission countershaft bearing sleeve that is ground internally and externally at the same setting on surfaces *A* and *B*, respectively. This fixture

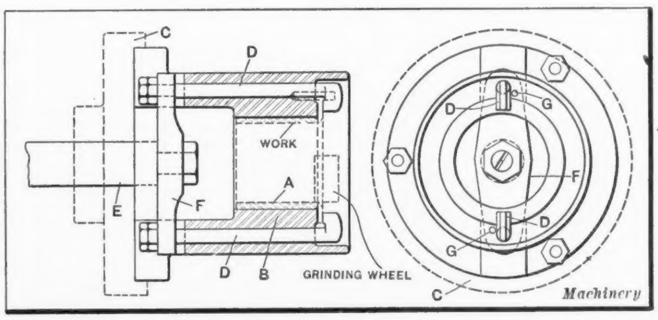


Fig. 15. Recommended Method of holding Thin-wall Bushing for Internal Grinding to prevent springing out of Shape

is of comparatively simple design, and comprises a special cap *C*, screwed onto the nose of the machine spindle and machined on the front end to fit the work. The work, in this case, is provided with a series of grooves which are engaged by projections on cap *C* for driving. The work is then held up against the face of the cap by draw-in bolt *D* that passes through the machine spindle and is operated by handwheel *E*. This bolt is supported in the spindle to keep it from wobbling by means of bushing *F*.

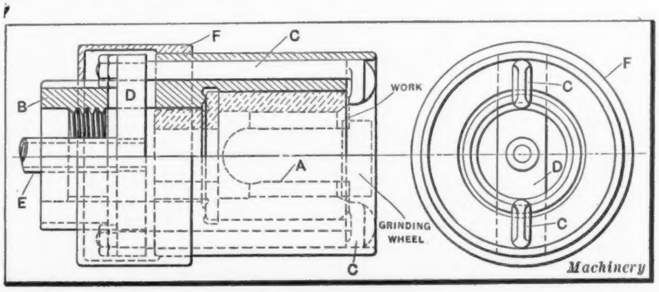


Fig. 16. Satisfactory Device for holding a Main Drive Yoke that is easily sprung out of Shape

Methods of Chucking Gears for Grinding

The problem of holding gears accurately is a difficult one, especially if they have been hardened. The chief trouble, of course, is making provision for possible inaccuracies that are caused by warping in hardening. There are several methods in commercial use, as follows:

1. Holding gear by outside diameters or tops of teeth.
2. Using rolls between the teeth, sometimes called the "pitch-line control method."

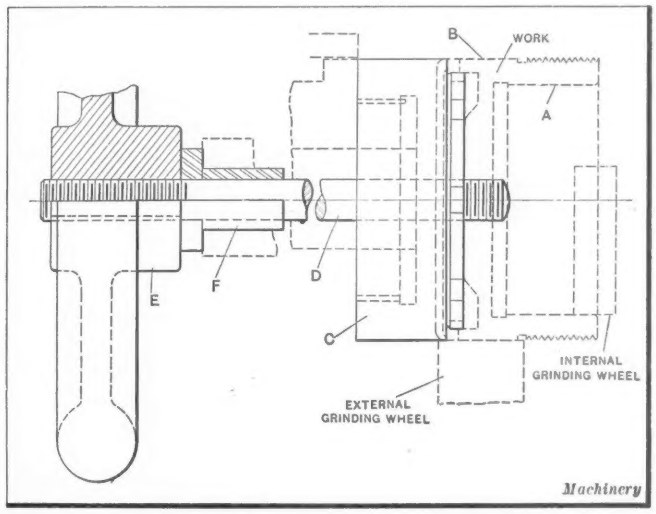


Fig. 17. Method of holding Sleeve for grinding Internal and External Diameters at Same Setting

3. Using jaws of special shape which make contact with the gear at the bottom of the tooth space, known as "root control."

The first method cannot be used with success when the gears are to run at high speeds, because the hole and the pitch diameter of the teeth may not be concentric.

The second method, while requiring the use of a more expensive chuck, is much more satisfactory than the first, if the teeth are fairly evenly spaced. A slight variation in the width of the tooth spaces makes a considerable difference in the relative positions of the rolls, owing to the acute angle made by the tooth surfaces near the pitch line where the rolls contact. This has been considered by some manufacturers as a serious objection to the use of this method, but when it is remembered that gears in which the teeth are unevenly spaced are unsatisfactory for high-speed work, and that prop-

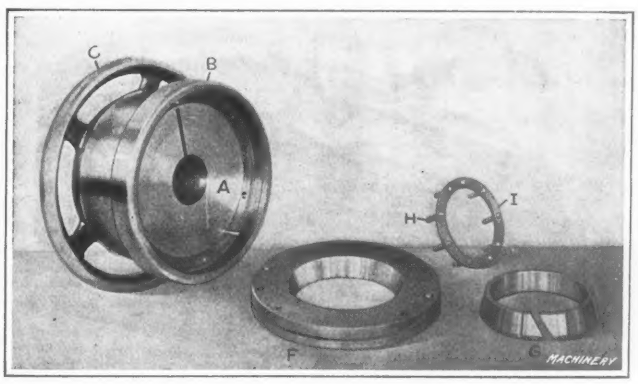


Fig. 18. "Pitch Line Control" Type of Chuck for holding Spur Gears

erly cut gears bear heaviest on the pitch line, it will be seen that the "pitch-line control" method is not devoid of merit.

For the average run of work, the third method is generally recommended. The jaws of the chuck contact directly with the solid metal at the bottom of the tooth spaces so that inaccuracies in the spacing of the teeth do not affect the accurate holding of the gear. Furthermore, it is a very simple matter to maintain the accuracy of the jaws by simply truing the contact points whenever necessary. This does away with continual truing when chucking each gear and effects an enormous saving where large quantities of one size are being

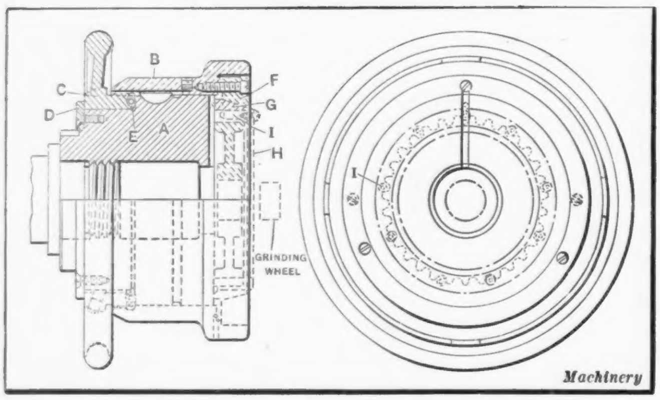


Fig. 19. Details of Spur Gear Chuck shown in Fig. 18, designed by the Heald Machine Co.

turned out. In the following, examples will be shown covering the three methods of holding spur and bevel gears.

Fixture for Holding Spur Gears for Grinding

In the grinding of holes in spur gears, it is essential that the hole be true and concentric with the pitch circle of the gear teeth, and in order to accomplish this satisfactorily, where the teeth are evenly spaced, it is sometimes advisable to locate the gear from the pitch circle. One method of accomplishing this is shown in Figs. 18 and 19. The fixture, which is screwed onto the nose of a Heald internal grinding machine, comprises a cast-iron chuck *A* and a brass clamping sleeve *B*. As shown in Fig. 19, sleeve *B* is keyed to chuck *A* so that it can be drawn back and forth without rotating independently. This sleeve is operated by means of a handwheel *C* having a projection which is threaded into sleeve *B*. The handwheel is held on the fixture by means of a brass retaining ring *D*, and in order to eliminate friction, ball bearing *E* is interposed between the fixture and the handwheel. Sleeve *B* carries the tapered cast-iron filler ring *F* that is held to it by means of fillister-head screws as illustrated. This operates hardened steel split clamping ring *G*, inside of which is located retaining ring *H* that carries nine rolls *I*. Rolls *I* locate

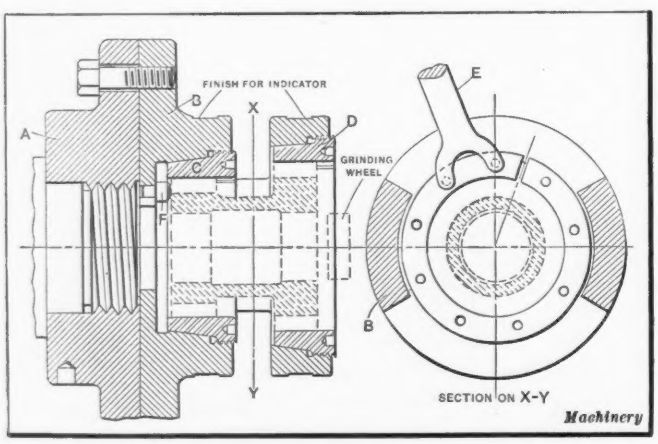


Fig. 20. Special Type of Chuck for holding Double Spur Gear, made by Heald Machine Co.

and grip the gear from the pitch circle of the teeth. As handwheel *C* is operated, it draws in split sleeve *G*, closing the pins down on the teeth and holding the gear rigidly and accurately in position while the hole is being ground. Parts *F*, *G*, *H*, and *I* have to be made special for each size of gear that is handled.

An interesting chuck for holding a double spur gear is shown in Fig. 20. The construction of this chuck differs somewhat from that previously described, chiefly in the method of clamping. It comprises a special faceplate *A* screwed onto the nose of the spindle, to which is clamped the chuck housing *B*. In this chuck, means are provided for holding and locating the gear from both external diameters. It is clamped on both diameters by cone-shaped split bushings *C* and *D* that are tightened on the work by means of the spanner wrench *E*. In order to get at the rear cone *C* with the wrench, the fixture is cut away as illustrated. This method of holding a spur gear cannot be considered as accurate as holding it from the pitch circle, but where the gear has been carefully made fairly accurate results can be secured. Hardened steel pin *F* is provided for the gear to butt up against and give point contact. When being replaced on the machine to turn out an additional lot of work, the chuck is trued up with an indicator, and finished surfaces, as indicated, are provided for this purpose.

Holding Bevel Pinions and Gears for Grinding

There is a diversity of opinion among users of grinding machines regarding the most desirable method of holding bevel gears and pinions for grinding. A device which has proved successful in one shop is not always looked upon with favor in another, and it is sometimes difficult to get men responsible for results to realize the advantage of a certain method if it differs from that which they are accustomed to. The Heald Machine Co. has given the problem of chucking gears for grinding considerable study and has devised several interesting chucks that are shown in the following.

One important point about which a diversity of opinion exists is the shape of the rolls used in chucks of the pitch-line

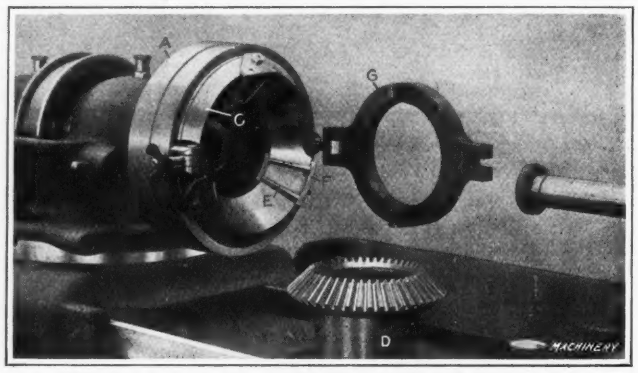


Fig. 21. Satisfactory Type of Chuck for holding Bevel Gears when grinding Hole

control type. Some gear manufacturers claim that cylindrical rolls are just as satisfactory as tapered rolls. After considerable experience in this direction, the Heald Machine Co. has found that the rolls for chucking bevel gears should be tapered because they make contact with curved surfaces, the elements of which converge at a common vanishing point. This company has also found that gear manufacturers using cylindrical rolls have used them exclusively on gears having a face width that is small in proportion to the diameter of the gear, as, for example, ring gears used in automobile transmissions. In such cases the error is not very pronounced, but on miter gears, especially when the face width is from one-quarter to one-fifth the gear diameter, there is a decided tendency for the gear to rock on a cylindrical roll at the central point of the face of the gear tooth.

A satisfactory method of calculating the diameter and taper

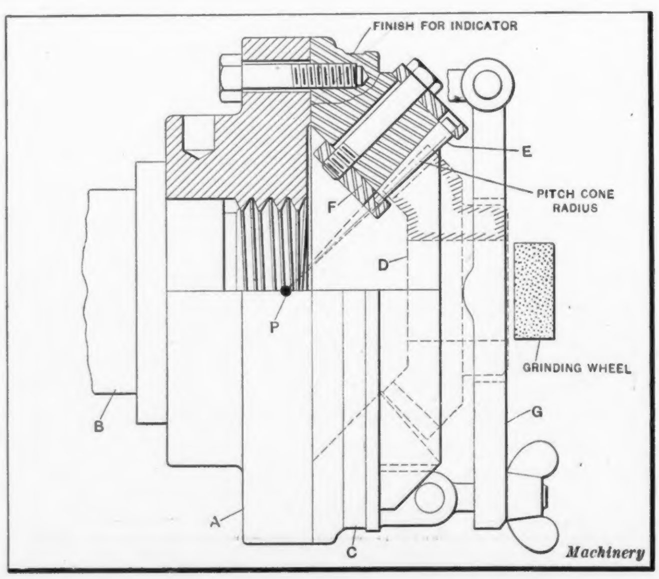


Fig. 22. Detail View showing Construction of Bevel Gear Chuck illustrated in Fig. 21

on the roll is to make the diameter at the large end sufficient to bring the surface of the roll about 1/16 inch above the outside diameter of the gear teeth. The taper on the roll should be such as would cause it, if extended, to converge at the apex *P* of the pitch cone, as shown in Fig. 22. If the rolls are made to contact properly with the tooth surfaces, the points of contact must lie in a line running from the large end of the tooth to the vanishing point of the pitch cone. Working on this basis it is not difficult to lay out the included angle of the rolls with considerable accuracy. In making the rolls, the taper can be checked up by inserting them between the teeth on opposite sides of the gear, thus forming a temporary gage. The best method of holding the rolls when they have once been properly made is a difficult problem, and this will receive attention in the various designs that follow.

Chucks for Holding Bevel Gears and Pinions for Grinding

The chucking of bevel gear and pinion blanks presents con-

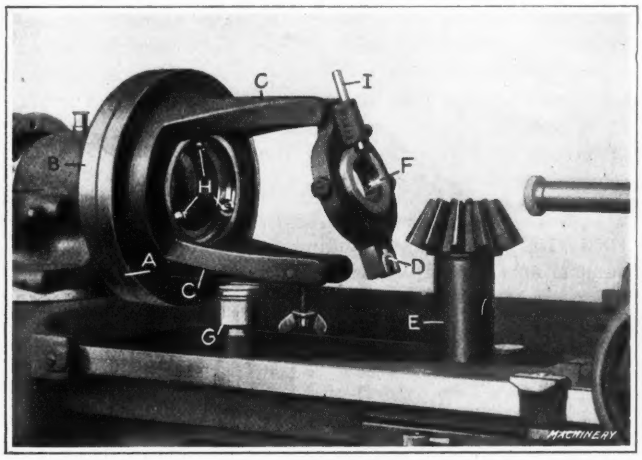


Fig. 23. Chuck for holding Long Shank Bevel Gear for grinding

siderable difficulty, as it is necessary to have the teeth run accurately with the hole. A satisfactory way of accomplishing this, of course, is to locate the gear from the pitch line of the teeth. Several methods of doing this are in use, but the most satisfactory way, as previously described, is to use tapered rolls located at various intervals around the circumference, placed between the teeth and locating the gear in the correct position relative to the pitch line. These tapered rolls can be made to fit the entire length of the face of the tooth, and are so held that any slight variations in the gear due to hardening are fully taken care of. The type of chucks to be described will be found an excellent means of locating gears of this kind when it is desired to have them run at high speeds and still remain quiet.

One type of chuck for holding bevel pinions is shown in Figs. 21 and 22. Fig. 21 shows the chuck in use on a Heald internal grinding machine, whereas Fig. 22 shows a part sectional view, illustrating its construction. Referring to these illustrations, it will be seen that there are three sets of tapered rolls arranged in pairs. This chuck comprises a faceplate *A* screwed onto the grinding machine spindle *B*. Secured to

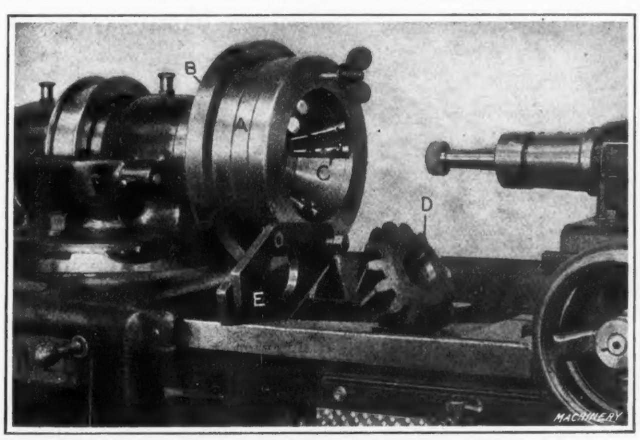


Fig. 24. Another Chuck for holding Bevel Pinions when grinding Hole

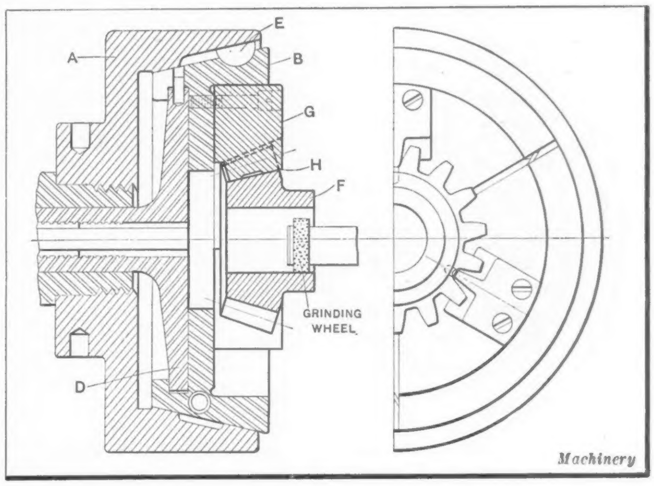


Fig. 25. Draw-in Collet for holding Small Bevel Pinions by Means of Jaws which engage Bottom of Tooth Spaces

faceplate *A* by screws, as shown, is a second plate *C* recessed to a suitable angle to receive gear *D* and rolls *E*. The rolls are retained in triangular-shaped plates *F* by capscrews that hold the plates and rolls firmly to the plate *C* and also prevent dirt from getting under the rolls. The rolls are held so as to allow for a slight movement in order that they can adjust themselves with relation to the gear teeth. The gear *D* is held in place by a yoke *G* and thumb-screw, as shown. This yoke exerts a pressure in a line parallel with the axis of the gear, and assists in forcing the gear back to a concentric location.

Another type of chuck for holding a bevel pinion with a long shank is shown in Fig. 23. In this case the fixture *A* which is fastened to faceplate *B* is provided with extension arms *C* that carry the clamping strap *D*. Gear *E* is 8 11/64 inches long over all, and the hole ground is 6⅛ inches long by 2⅜ inches diameter. The clamping strap *D* carries bushing *F*, in which the centering plug *G* fits to locate the shank of the pinion when it is being clamped in position. The gear is centered at the inner end from the pitch line of the teeth

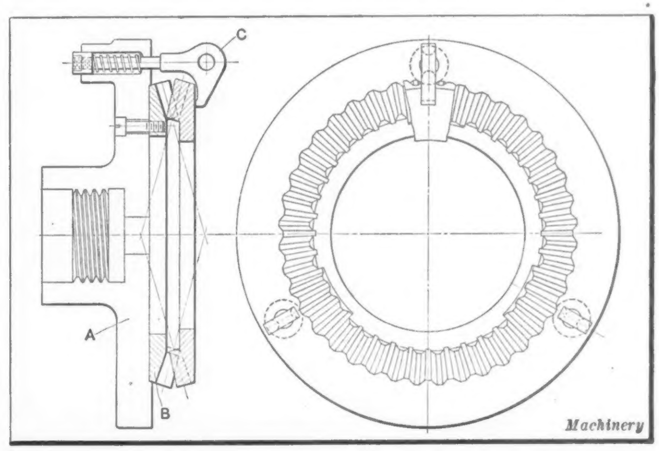


Fig. 26. Fixture for holding Bevel Ring Gears having a Master Gear against which Work is clamped

by three balls *H* held in place by screws, as shown. The inner end of bushing *F* is chamfered to center the shank.

Another point worthy of notice in connection with this fixture is the device for truing the internal grinding wheel. The diamond holder *I*, as will be noticed, is held in a projection on the clamping plate *D* by a knurled-head screw. In truing the wheel, the work-spindle is stopped, the diamond brought down until it contacts with the wheel, and then the wheel-slide traversed back and forth.

The chuck shown in Fig. 24 illustrates another method of locating and holding bevel pinions for grinding. The construction of this chuck bears a marked resemblance to that shown in Figs. 21 and 22 with the exception of the arrangement of the tapered pins for locating the pinion from the pitch circle of the teeth. In this case six tapered pins *C* are held in the chuck *A* by screws, as shown, the latter being fastened

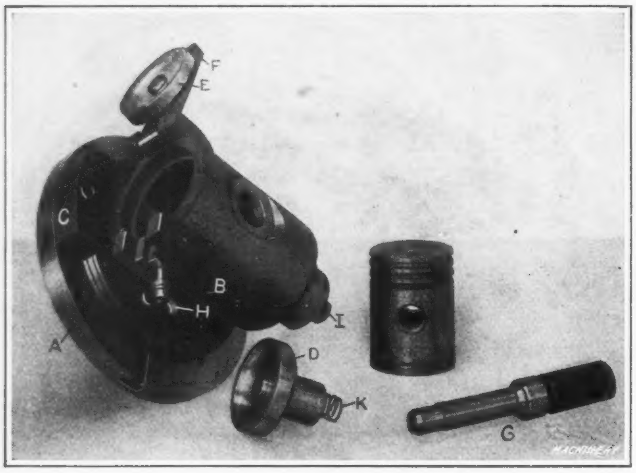


Fig. 27. Special Fixture for holding Gas Engine Pistons for grinding Wrist-pin Holes

to the faceplate in the usual manner. The gear *D* is held in place by clamping strap *E* which carries two hardened pins that come in contact with the rear face of the gear. This method of fastening the rolls can be used in this case because of the coarse pitch of the gear teeth.

Draw-in Chuck for Holding Small Bevel Pinions

When the bevel pinion to be ground is of comparatively small size, the Heald standard type of draw-in collet shown in Fig. 25 can be used. This comprises a cast-iron cap *A*, screwed onto the nose of the machine spindle and machined to receive the tapered ring *B*. The draw-in rod is screwed into a flange-shaped draw-bar *D* that is pinned to ring *B* as shown, the latter being prevented from turning independently of the cap *A* by a Woodruff key *E*. Ring *B*, in turn, is cupped out to receive gear *F* which is held in place by three jaws *G*, fastened to the ring by screws as shown. Jaws *G* are provided with small projections which extend over the outside of the gear, as shown at *H*, and prevent it from sliding out as the jaws are closed. Hence, by simply opening and closing the jaws, the gear is clamped and released, without the aid of straps or yokes. One objection to this device is that if the teeth of the jaws do not have an even bearing on the bottom of the tooth spaces, chances of error will be introduced.

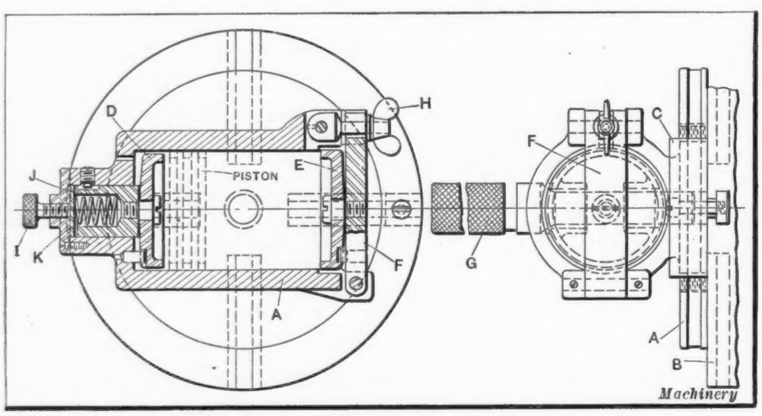


Fig. 28. Detail View of Special Work-holding Fixture shown in Fig. 27

Fixture for Holding Bevel Ring Gears

A fixture for holding bevel ring gears while grinding the hole and the back face, when necessary, is shown in Fig. 26. This comprises a faceplate *A* recessed to receive a ring gear *B* of the same size and shape as the one to be ground. About three-quarters of the inner points of the teeth on this ring gear, which is left soft, are cut away, so as to leave three points containing three or four teeth each. The gear to be ground is then placed up against this "gear chuck" where it is clamped with three toe-clamps as illustrated. This device is self-centering, it only being necessary to place the gear so that the teeth will fit those teeth on the other gear which have not been cut away. The gear teeth that are in mesh also form a positive drive, and the holding mechanism simply keeps the gear in contact with the master or chuck. Repair of the master gear can be taken care of by grinding the high teeth and in this way obtaining the original accuracy.

Grinding Fixture for Gas-engine Pistons

The wrist-pin holes in the pistons of the H. H. Franklin Mfg. Co.'s automobile gas engine are provided with bronze bushings which are ground true after being forced in. The grinding is accomplished in a Heald internal grinding machine provided with a special fixture shown in Fig. 27. A clearer idea of the construction of this fixture can be obtained from Fig. 28. The fixture proper *A* is fastened to the faceplate *B*, located on the machine spindle, by two clamping blocks *C*, only one of which is shown in Fig. 27. These are adjusted so that the wrist-pin hole of the piston can be centered with the axis of the work-spindle. The hole in the fixture is accurately ground and is a good fit for the external diameter of the piston. Located at the bottom of this hole is a spring-operated bottom plate *D* that holds the piston up against the top plate *E* fastened to the swinging clamping plate *F*.

The method of locating the piston in the fixture is as follows: The piston is first put in, then the plug gage *G* is used to locate it from the previously reamed hole in the bushing. Clamping arm *F* is now swung down and thumb-nut *H* on the swinging bolt tightened. If the spring pressure on the bottom plate is not sufficient, screw *I*, Fig. 28, is adjusted; this operates against plate *J* and through spring *K* adjusts the sleeve carrying the bottom plate. When the piston is properly clamped, the plug gage is removed and the grinding proceeds. In a fixture of this type the chief requirement is to grind a hole accurately at right angles to the axis of the piston, and this fixture satisfactorily solves the problem.

Adjustable Work-holding Fixture

Fig. 29 shows an interesting work-holding fixture applied to a Heald No. 70 internal grinding machine. The work being ground is an air pump cylinder, in which four holes 1¼ inch long by ¾ inch diameter must be ground. The fixture proper *B* is held in place on the faceplate *A* by two guide bars *C*. The pump cylinder casting *D* is held to the sliding or adjustable member *B* of the fixture by means of clamps *E* and clamping-screws, as illustrated. To locate each hole in line with the work-spindle, clamps *E* are released and slide *B* moved along until plug *F*, which is previously located in the hole it is intended to grind, locates the casting properly by fitting in the aligning hole in the fixture. The fixture is counterbalanced by means of plate *G*, and in order to keep as perfect a balance as possible, the casting is reversed end for end.

Work-holding Fixture for Rotary Surface Grinder

An interesting fixture for holding a sleeve while grinding the top of the flange in a Heald rotary surface grinder is shown in Fig. 30. This fixture is designed to be clamped to

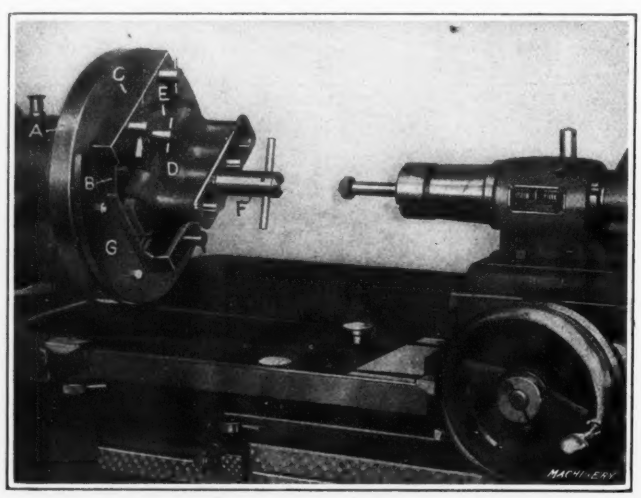


Fig. 29. Fixture for holding a Four-hole Air Pump Cylinder

the table of the machine and carries twenty-eight bushings which are ground at one time. The method of holding the bushings is interesting and is shown diagrammatically in the center of the illustration. The clamping is done by levers *A* fastened to clamping bolts *B* that pass through the rim of the fixture and operate on plates *C* to which the clamping members proper are attached. Two bushings are clamped by each pin *D* which fit in the counterbored recess in the fixture and are kept out of contact with the work by means of coil springs *E*, as illustrated. As soon as clamping levers *A* are pushed down, they operate a cam surface coming in contact with the hardened cams held in plates *C*.

Fixture for Holding Roller Bearing Rolls on Blanchard Vertical Surface Grinder

Many interesting fixtures have been devised for the Blanchard vertical surface grinder, to act as an auxiliary holding device in connection with the magnetic chuck. One of these devices, used for holding roller bearing rolls, is shown in Fig. 32. This comprises a base *A*, to which are clamped two rows of segment blocks *B*. The rolls, both ends of which are to be ground, are, in turn, clamped in vee recesses in the sides of the block, as illustrated—one clamp holding two rolls in place. Two fixtures of this type are provided, so that when the machine is grinding one end of the batch of forty rolls, the other fixture is being loaded, thus keeping the machine in practically continuous operation. Measurements are taken with a Blanchard direct-reading micrometer.

Holding Work by Magnetic Chucks

As an effective device for holding a large number of small parts at one time for grinding, and in fact for a considerably large range of work, the magnetic chuck is without an equal. Magnetic chucks are made in a variety of sizes and shapes, depending upon the type of machine they are used on and the character or shape of the work to be handled. As a fixture for holding work for internal grinding, their use is limited somewhat, their greatest field of usefulness being on surface grinding machines of the reciprocating and rotary types. One of the chief advantages of the magnetic chuck is the short time required to change the work, this being in some cases only a fraction of a minute. Another advantage of the magnetic chuck is the greater degree of accuracy that can usually be obtained.

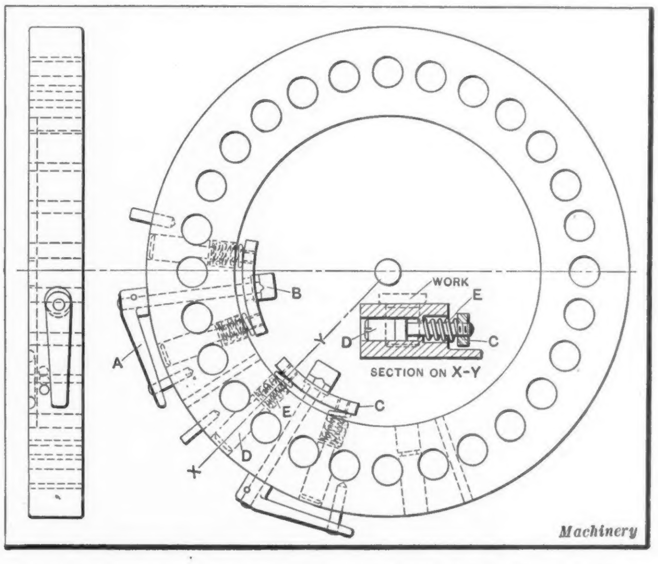


Fig. 30. Special Fixture for holding Twenty-eight Bushings on Heald Rotary Surface Grinder for grinding Top Face of Flange

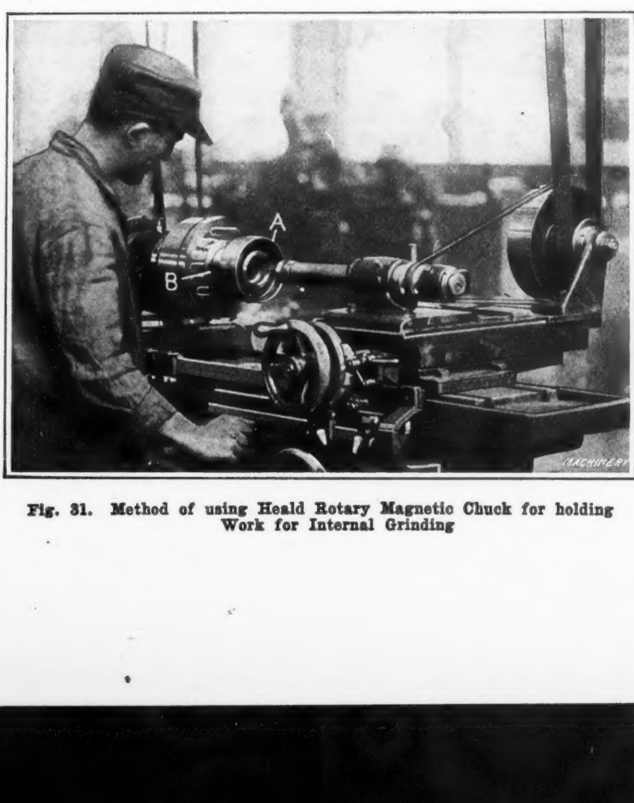


Fig. 31. Method of using Heald Rotary Magnetic Chuck for holding Work for Internal Grinding

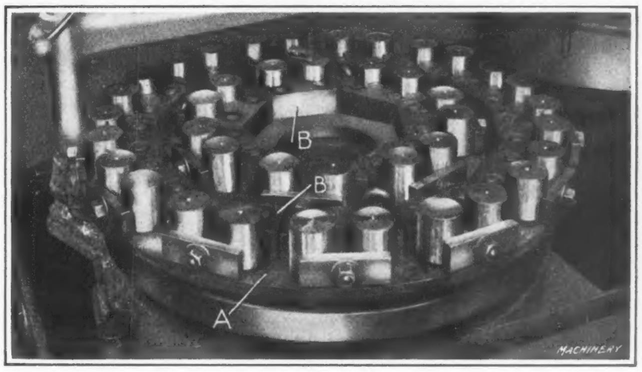


Fig. 32. Special Fixture for holding Roller Bearing Rolls on Blanchard Vertical Surface Grinder

Holding Work by Magnetic Chucks for Internal Grinding

Fig. 31 shows a Heald rotary magnetic chuck being used for holding a two-step pulley *A* when grinding the hole. The pulley is held directly to the face of the chuck by the magnetic flux and is prevented from shifting by ring *B*. The "grip" of the chuck is sufficient to hold the work when taking quite heavy cuts with an internal grinding wheel, and the rapidity with which the work can be removed and replaced makes this method especially advantageous for certain classes of work. Many other applications of magnetic chucks to internal grinding could be shown, but the one illustrated in Fig. 31 is sufficient to show the general application.

Construction of Heald Rotary Magnetic Chuck

For holding work for surface grinding, the Heald rotary magnetic chuck shown in Fig. 33 can be used to advantage, especially on thin work. The body *A* of the chuck is made from soft steel of high magnetic permeability and the pole pieces are located close together, thus giving more frequent holding points as well as great magnetic pull, and making it possible to hold smaller individual pieces securely. The wiring of the chuck is carefully worked out, so that the pull at any point, from the center to the circumference, does not vary more than 5 per cent. The faceplate *B* is held in position on the body of the chuck by means of brass screws from the under side, thus eliminating all screw holes on the face of the chuck. The non-magnetic material, it will also be noticed, is comparatively narrow in proportion to the width of the poles, and is held in tapered grooves as illustrated. The body of the chuck has projections *C* cast integral with it that receive the coils *D* and carry the magnetism to the pole pieces *E* in the faceplate of the chuck. The coils slip over the projections and the top face is finished even with the sides or walls of the chuck body. The pole pieces are insulated from the remainder of the faceplate by means of a non-magnetic metal or insulation *F*. The faceplate *B* is also insulated by means of a ring of non-magnetic metal *G*, which prevents the magnetism from leaking into the body of the chuck. On the rotary type of chuck, which is illustrated in Fig. 33, the current is delivered to a set of brushes which contact with two rings *H* and *I* of conducting material. These rings are insulated from the body of the chuck by a non-magnetic ring. As to the current consumed, it might be stated that a 12-inch rotary chuck requires only 0.6 ampere of current, and an 8-inch rotary chuck 0.4 ampere. These chucks may be used on a direct-current circuit of either 110 or 220 volts.

Blanchard Magnetic Chuck

Another magnetic chuck used for holding work, and one that differs somewhat in construction from that illustrated in Fig. 33, is shown in Figs. 34 and 35. This type of chuck is used on the Blanchard high-power vertical surface grinder, and as shown in Fig. 34, is of the fine "divided pole" type. The poles are all formed on a single steel forging *A*, which makes the working face of the chuck absolutely water-tight and very rigid. Only four coils are used, but each coil energizes four ring poles which are so closely spaced that a piece of work of the size of a nickel would touch two poles no matter where it were placed on the working face of the chuck. The sixteen ring poles of the chuck are also concentric. Referring to Fig. 34, it will be noticed that the construction amounts to a series of four ironclad magnets *B*, nested one inside of the other, the shell of one magnet serving as the core of the next on the outside. The chuck body has four large concentric grooves machined in one side to receive the

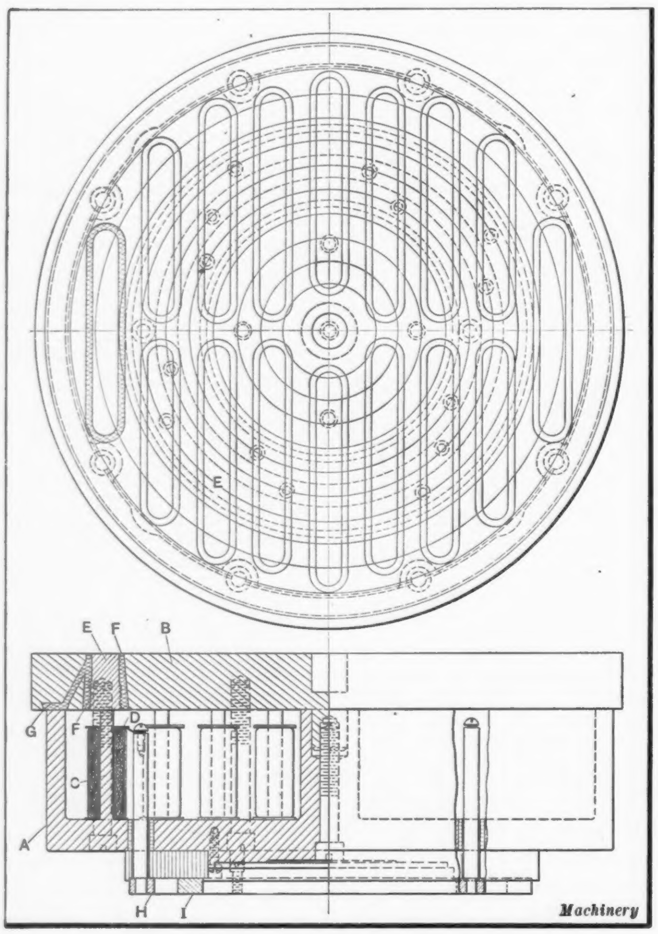


Fig. 33. Heald 12-inch Rotary Magnetic Chuck

coils, while the opposite face of the forging has fifteen grooves machined in it to receive the brass strips which divide the face of the chuck up into sixteen ring poles. These grooves in the face of the chuck are 3/16 inch wide by ¾ inch deep, and are filled with strip brass, driven tightly into place. A safety flange is provided at the circumference of the chuck to prevent water from reaching the joint between the chuck body and the bottom plate. Fig. 35 shows the supposed path that the magnetic flux takes when holding thin work. The piece being held is 1/16 inch thick, and the total distance between the poles is 2 1/16 inches. This distance, however, is divided into four spaces, 3/16 inch wide and filled with brass, and three intermediate poles 7/16 inch in width. Instead of having to traverse a distance of 2 1/16 inches in a strip of steel 1/16 inch thick, the magnetic flux has to travel only ¾ inch—the sum of the intermediate spaces filled with brass—the rest of the way the intermediate poles offer a greatly increased area of path for the flux. This results in lowering the resistance of the path, and thus increasing the magnetic flux and holding power of the chuck. In holding heavy pieces, it is believed that the intermediate poles play a small part, as there is sufficient area in the path to allow the magnetic flux to pass easily from one pole to the next. The terminals of this chuck are connected by a direct-current circuit of either 110 or 220 volts. Steel or iron work held on magnetic chucks becomes magnetized, and a demagnetizer is used to remove the residual magnetism.

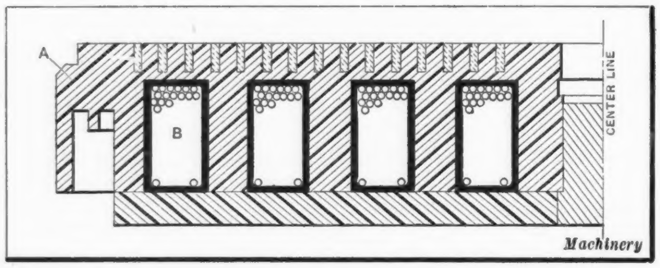


Fig. 34. Cross-sectional View taken on Radial Line from Center, showing Construction of Blanchard Magnetic Chuck

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RESTRICTION OF IMPORTATION OF MACHINE TOOLS INTO GREAT BRITAIN

A. H. Baldwin, London commercial attaché of the consular service, reported in the January 3 number of *Commerce Reports* that the restriction of the importation of machine tools into Great Britain is a part of the general war control of manufactures, imports and exports by the government, and that the primary impulse comes from the war munitions board, which controls many factories and, in general, has the power to make such restrictions as may seem necessary for the conduct of the war. Machine tools are so important that the board of trade has been requested to take charge of the issuance of licenses for the importation of these products, instead of the war trade department which furnishes the licenses for export. In order to import machine tools, British importing houses or manufacturers, as purchasers, must first obtain permission from the board of trade and must make certain agreements with respect to their disposal. Importers who desire to resell machine tools are restricted as to profits, and definite permission must be obtained before any machine tools can be exported. It apparently is not the intention to prevent such importation, but merely to control the imports so that the interests of the government will be served.

In this connection, it is interesting to note also that the minister of munitions has prohibited all dealings without license in certain optical instruments, including prismatic binoculars, monoculars, telescopes, periscopes and compasses for reading an azimuth angle simultaneously with sighting an object.

* * *

The scarcity of nickel and copper in Germany is indicated by an item in a publication by the American Association of Commerce and Trade in Berlin, in which it is mentioned that the German government has issued 60,000,000 steel coins. These coins will be withdrawn from circulation within two years after the war. Although not so stated, the natural inference is that the present nickel and copper coins are melted down and used for ammunition purposes.

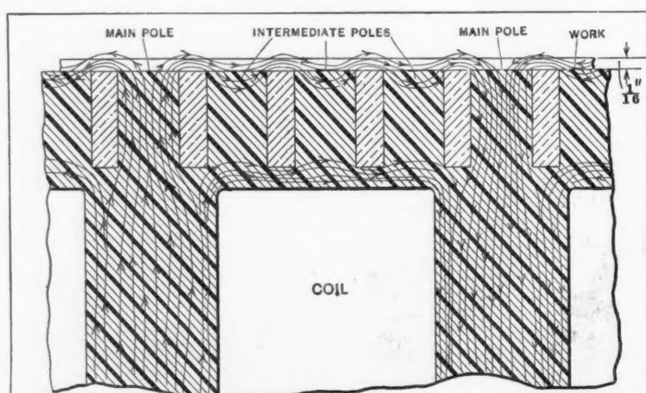

Fig. 35. Diagram showing Path of Magnetic Flux in Blanchard Magnetic Chuck when holding Thin Work

HOW TO GO AFTER SOUTH AMERICAN TRADE*

AMERICAN MACHINE TOOLS HAVE EXCELLENT REPUTATION—MANUFACTURERS NEED PERSONAL REPRESENTATION

BY R. W. GIFFORD†

EVERY manufacturer of machine tools is more or less interested in export trade, and since the outbreak of the present European war his attentions have been more than ever directed toward our South American neighbors. To those who are already familiar with these markets, very little need be said. Unfortunately, only a few of our manufacturers have had any personal experience in these countries. Their knowledge of the size and importance of the various countries and their markets is so slight, and the distance seems so great, that no matter how desirous they may be of extending their trade in this direction, they hesitate to take the necessary steps.

It is self-evident that with Europe engaged in the present war, the opportunity for American manufacturers to expand their foreign trade is better than ever before. We, as Americans, have always prided ourselves on our ability to get almost anything we go after, but now is the time to prove our claim. That this statement is founded on facts and realized by others is clearly shown by a statement the writer heard made by a prominent English manufacturer, while slowly steaming down the east coast of South America. A group of us on deck had been discussing everything in general until the talk had turned to the ever important race between England and Germany for commercial supremacy. Finally the Englishman referred to above, turned to me and made this statement: "We, of course, expect to keep the lead but some day you Americans and your government will wake up to the fact that you have long been asleep and are getting only a small share of the trade to which you are entitled. Then you will be more serious competitors than the Germans ever can be." Who will dispute the fact that now is the time to awake and go after what we feel should rightfully be ours?

At the outset it is well to bear in mind that American machine tools lead the world. This is recognized everywhere, but in spite of this, in many countries we have failed to get our share of business. In calling on the machinery trade from Cuba to the Straits of Magellan, the writer has yet to encounter a single dealer who does not speak in the very best terms of American tools. He may spend an hour condemning the methods of some of our exporting houses but never in condemning the machines themselves. In this we are extremely fortunate, for with most of our manufactured articles we have a hard but by no means a hopeless fight ahead of us. In Europe where the demands are greater and where most Americans feel very much at home, the majority of our larger machine tool houses maintain their own branches. As a result, we export millions of dollars worth of machinery every year to these countries. At the same time, how many of these firms have ever given serious consideration to the possible demands in many sections of South America?

The principal reason why a great many of our firms have not been more interested in South American trade has been because of the demand at home. This is quite largely due to the enormous development in the automobile and allied lines which have taken machine tools in quantities that were previously almost unknown. The resulting increased production of machine tools has now taken care of this demand and even before the business depression due to the war, many of our manufacturers were spending considerable energy in developing more distant fields.

Few realize the importance of South American markets unless they have actually visited at least some of the important cities. The time is not so far distant when, if South America was mentioned, we immediately had in our mind a confused picture of tropical jungles, boa constrictors, yellow fever and revolutions; but the time for all of this is passed. All now know more or less about Rio-de-Janeiro and Buenos Aires, although how many who have not actually traveled south can give the names of two other cities in either Brazil or the Argentine, not to say anything about the other countries concerning which we know almost nothing? In fact, it is a safe wager that in the majority of offices there is not one who can, without previous thought, make a complete list of the South American countries; or with the list furnished them, can write down the capital cities only. I have tried this several times and the results are amusing, even among a well posted staff. In one case I asked a mechanical engineer, who is a graduate of one of our largest Eastern Universities, what he estimated the population of Buenos Aires to be. After making some excuse for his lack of knowledge, he made what he called a rough guess, placing it at 20,000. When one remembers that it is well above 1,250,000, the extent of his knowledge can be appreciated.

The countries with which we are best acquainted are Brazil and the Argentine, due to their greater wealth and prominence; but every country in South America has a permanent and rapidly increasing market for machine tools. It is true that the demand in either of these countries will probably never equal that in the United States or even Canada, but at the same time the extent of this demand and the rapidity of its growth will surprise you. Take, for example, the Argentine Republic—a country about equal in area to our own country east of the Mississippi River. It already ranks as one of the greatest grain exporting countries of the world, and its cattle industries are also taking an important place in the meat supplies of the world. The population is about equal that of Canada and in many ways the two countries are somewhat similar. No one would for a minute dispute the importance of our Canadian markets. Now imagine all the goods imported into Canada going through the port of Montreal or Toronto and you have a condition similar to that in the Argentine. In other words, while there are other important cities besides Buenos Aires, almost all goods are bought and sold through this one city.

In a country so rich agriculturally, it follows that there must be a rapidly increasing demand for machine tools. The railroads are pushing out in every direction and opening up new territory, and the cities are fast assuming the appearance of our own. While manufacturing in the Argentine Republic is practically in its infancy, nevertheless it has already assumed very considerable proportions. Certain branches of trade and manufacturing are, of course, developing more rapidly than others due to the nature of the country and its products; and some of our American industries have not been slow to realize this. For example, the representatives of the American Shoe Machinery Co. have been on the ground for years, installing, organizing and operating factories, not only on the east coast but on the west coast as well. To attempt to enumerate the various uses to which machine tools are put would be as difficult as to do the same in St. Louis, Kansas City or Indianapolis. They are used everywhere, but as stated previously, in smaller quantities.

The demand in Brazil is even more varied than in the Argentine. It is a country with an area greater than that of the United States (without Alaska) and natural resources that are not excelled by any country on the globe. Gold, diamonds, rubber, coffee and other products too numerous to mention abound in quantities which are almost unlimited. Foreign capitalists have poured in hundreds of millions of

* For additional information on the development of South American machine tool trade and allied subjects published in MACHINERY, see also "Establishment of American Banking Facilities in South America," by H. R. Eldridge, November, 1914; "Important Details in South American Trade," October, 1914; "Export and Import Trade" by George Scherr, June, 1914, and other articles there referred to.

† Treasurer and superintendent, Deyo-Macey Engine Co., Binghamton, N. Y.

dollars and today we find Brazilian industrial stocks listed in almost all our important cities. This is especially true in Canadian cities, as our near neighbors, led by the famous railroad builders McKenzie & Mann, have been among the leaders in developing Brazilian fields. Railroads have branched out in every direction, while their system of natural water ways is the greatest in the world. To describe even a few of the cities in Brazil with their industries would require a book; to visit and become acquainted with them takes months. However, no matter where you travel, whether it be a thousand miles up the Amazon or in any of its many large coast cities, the market for machine tools will be found. This market, unlike the River of Doubt, has long been discovered by our English and German competitors, but still remains a market of doubt to many in America.

We can only mention Uruguay with its beautiful capital city, Montevideo. The writer remembers well an extended visit around the city with an elderly English gentleman who had long been the head of the machinery department of one of the largest firms. He had spent forty-five years there and was well justified in his pride in both the city and its progress. Small industries were thriving everywhere, although here, as in the Argentine, their largest business resulted from the cattle industry. The west coast of South America is very different from the east, for previous to the completion of the Panama Canal there were no countries on the globe—unless it be East Africa—which were more isolated or harder to reach. When once familiar with these countries, however, this feeling of isolation entirely vanishes. Peru and Chile are as yet the only two west coast countries which have any established machine tool markets, but Colombia is developing slowly; Ecuador is still very much handicapped due to lack of sanitation. For years American capital has been interested in Peru more than in any other South American country. Unlike those of Chile, the merchants have a natural friendly feeling toward America and Americans, due probably to our interest in them. Mining is their most important industry and the field is almost unlimited.

In Chile we have a people called by some, "the British of South America"; and while this may be resented by the British, nevertheless there is some truth in this comparison. Geographically Chile is the strangest country on the globe, extending for more than 2000 miles along the Pacific coast. While we are inclined to consider Chile as all mountains, a fair comparison of the size of the country is often made by stating that if the southern boundary of Chile were placed at the southern extremity of California, the width would be approximately the same as that of California, while Chile would extend along our entire Pacific coast and part of the way into Alaska. All kinds of scenery and climate may be found, varying from the tropical desert of the north to the barren mountain section of Tierra-del-Fuego. Contrary to the general impression, Chile has in addition to her nitrate fields, fine farming lands. While the country is wedged in between the Andes and the sea, there lies between the coast range of hills and the Andes a flat, fertile plain which is approximately fifty miles wide and extends for hundreds of miles north and south. It is this level plain which is responsible for the agricultural wealth of the country. The people are a mixed race, descendents of the Spanish, but with a liberal sprinkling of Irish blood. They are hardy and aggressive, and already dominate affairs on the west coast. Valparaiso, Santiago, Concepcion, Valdivia and many others are flourishing cities, but Valparaiso leads in manufacturing.

The question of how to obtain a portion of this trade is uppermost in the minds of all; and the simplest and truest answer is easily expressed. Go after it! In other words, treat this market exactly as you would any section of your own country. What chance would the average machine tool manufacturer have of obtaining the trade in San Francisco if he had no representative on the ground? When the writer first visited South America and the West Indies, it was rather unusual to encounter a direct representative of any American machinery house, although such American firms as the International Harvester, Singer Sewing Machine Co., United Shoe Machinery Co. and Standard Oil Co. have representatives everywhere. A great many American machine tools were sold, but nearly all were purchased through some export agents in New York. The orders were, in a large measure, obtained unsolicited and no follow-up work was ever done to make sure that the machine was properly installed and giving satisfaction. Would we expect good results from sales of this kind even in our own country where manufacturers are familiar with modern machinery? If not, how can we look for something in South America which cannot be obtained here?

For the benefit of the manufacturer who has had little or no experience in South American markets, we would suggest that he first investigate Brazil and the Argentine Republic on the east coast, and Chile and Peru on the west. Their leading cities have machinery houses equal to those in our own cities. In fact, Buenos Aires has more than a dozen large firms, any of whom are capable of handling in their machinery department any line of good machine tools. So far, however, there is scarcely an American machine tool manufacturer having his own office in any of these cities. In planning to enter these markets, don't spend money in advertising unless you are prepared to follow it up. Personal work backed up by proper advertising is good, but don't expect paying results without personal work. The best representative is, if possible, some one from your own company. If this is not possible, then be sure that the man you select is some one thoroughly competent to handle your line and broad enough to study conditions intelligently.

If your tools are such as to warrant it, keep a man on the ground. If not, try to get your agents to send one of their own machinery salesmen to your factory. Remember that you are in competition with firms who have already done just these things, and the natural inclination of every salesman is to sell that with which he is best acquainted. You must also remember that almost all of the large machinery firms in South America are either English or German, or if Spanish, they have English or German managers of their machinery departments. They will always give preference to the tools of English or German make, unless the American tool is proved superior.

The question of credits should also be given consideration. This can always be arranged by any firm really willing to do business, and in the writer's opinion, the chances of loss are not as great as in our own trade. The South American machinery houses often have their own New York office but whether they have or not, you should remember that good houses there guard their credit standing even more than our own firms. Furthermore, either R. G. Dun & Co. or Bradstreets can furnish you reliable reports on firms in South America as readily as in our own country. These are all on file in New York and can be obtained at a very nominal figure. A traveler should also have a letter of introduction to the foreign offices of these companies so that an accurate rating of any prospect can be obtained while on the ground. In closing, it seems advisable to give a word of warning against the many fake exporting schemes which are now being advanced. Knowing that all manufacturers are interested in foreign trade as never before, the mails are full of letters and circulars telling of the wonderful chances to make money in export trade. Money can be made, but only by intelligent and consistent work.

* * *

MONTHLY MEETING OF THE A. S. M. E.

The monthly meeting of the American Society of Mechanical Engineers was held Tuesday evening, January 11, at the Engineering Societies building. It was addressed by Walter N. Polakov, the topic being the standardization of power plant operating costs. Mr. Polakov outlined a method by which the owner of a power plant can judge, without having to study the technical details of operating, how close the actual performance of the plant is to the possible minimum cost. All variable factors beyond operating control are automatically adjusted.

APPLICATION OF THE THREE-POINT PRINCIPLE IN FIXTURES

TOOLS FOR VARIOUS CLASSES OF HORIZONTAL AND VERTICAL TURRET LATHE WORK

BY ALBERT A. DOWD*

A stool with three legs can be placed on any uneven surface and yet be firmly supported, but a four-legged one is rigid only when the surface on which it rests is of such a nature that all the legs obtain a bearing. The farmer then, when he makes a milking stool, bears this point in mind and makes his stool three-legged, not because this construction is mechanically superior but because he knows that a four-legged stool will not give a firm support on the surface of the barn or stable floor. In the mechanical field the principle of three-point support is applicable to many classes of work and its importance is understood and made use of in every kind of machine and fixture work. In the automobile industry, alignment of the working parts is preserved by making the power plant a self-contained unit and having it supported on three points in order to equalize or neutralize the twisting action caused by the passage of the car over the more or less uneven surface of the road. If some provision of this kind were not made, distortion of the parts would result and they would consequently fail to perform their functions. Several years ago one or two manufacturers made a strong advertising point of this feature in their cars, and even at the present time one company uses a diagrammatic representation of the three-point support as a sort of trademark. All manufacturers now provide some form of three-point support for their power plant, although the working out of the principle varies somewhat according to the construction of the car.

In machine design the three-point principle is utilized in numerous ways, one of the most important of which is in the setting up and leveling of the machine itself. Machines of the lathe type, having four legs, are carefully leveled by shimming up under the feet, care being taken that strains are not produced in the machine bed or ways. Sometimes the bed itself is supported on two points at one end of the machine while the other has a single swivel bearing or its equivalent; and machines provided with this feature are easily set up without danger of distortion or changes in the alignment. The principle is applied to machine design in other ways to secure a solid support, to equalize strains, etc. Castings for various purposes are often made with three projecting lugs or bosses in order to gain a good bearing surface under all conditions. In the design of fixtures of all kinds the principle of three-point support is used in many ways, on both rough and finished work and on all varieties of machines. In this article, however, we shall consider its application to fixtures for horizontal and vertical turret lathe work, and in order to make the matter as clear as possible the examples selected are as simple as could be found to illustrate the subject and avoid complications. A few points worthy of note in connection with the design of fixtures employing the three-point principle are given herewith, and although some of these may appear so simple as to be obvious, it is believed that it is better to err on the safe side than to leave out some point of interest because it is well known.

* Address: 7909 Ridge Blvd., Brooklyn, N. Y.

Important Points in Design

1. The application of the three-point principle for the location and support of rough castings or forgings must be carefully thought out in order to make sure that none of the points will strike against a fin or parting seam, or come against the portion of the work on which the piece number may be imprinted. If the work is to be located from two rough surfaces at right angles to each other, it must be remembered that if three fixed points are used as locaters on one side, the other points must be arranged so that only one is fixed, and two are adjustable to compensate for variations in the surfaces. When the work is shallow and is held in chuck jaws this point may be neglected, as the work can rest on three points and be gripped by the jaws.

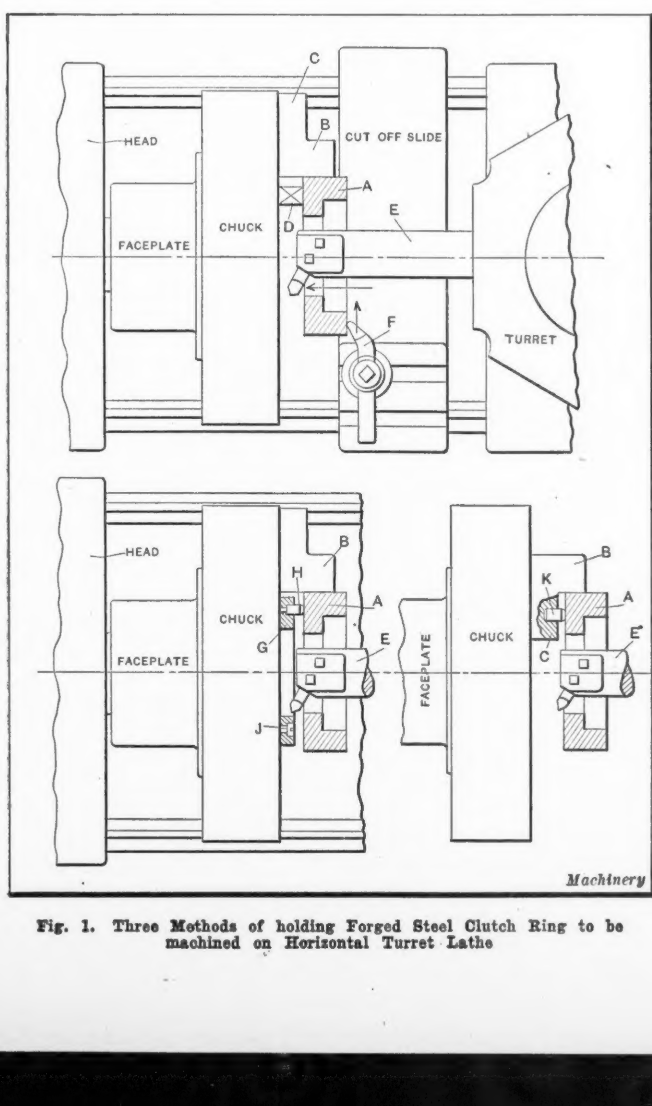

Fig. 1. Three Methods of holding Forged Steel Clutch Ring to be machined on Horizontal Turret Lathe

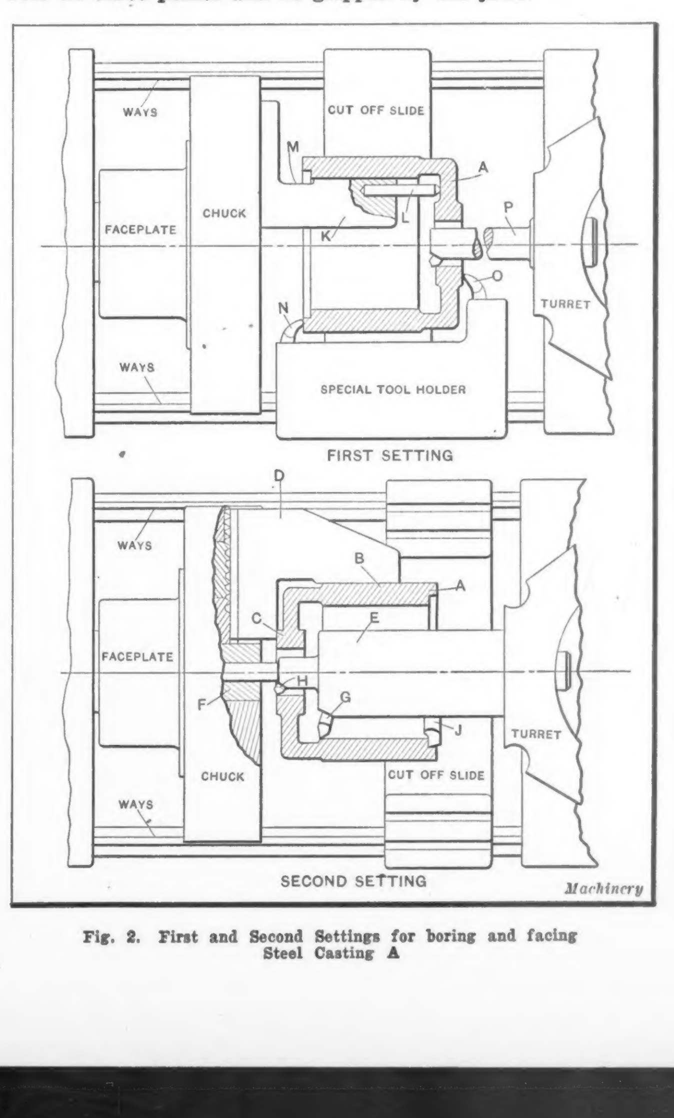

Fig. 2. First and Second Settings for boring and facing Steel Casting A

2. When a finished surface is used for centering the piece in the fixture, and it also rests on a finished surface, the three supporting points may be fixed. If the work is to be clamped as on a faceplate fixture, the clamps should be arranged so that they will draw the piece directly down or back onto the supports in order to avoid any chance of "cocking" or distortion. When a finished surface is used for centering the work and a rough one for end location, the points must be arranged the same as for handling rough castings, *i. e.*, with two of them adjustable. It is often desirable on large work to locate the piece on three strips instead of on a continuous surface in order to facilitate assembling. When this is necessary, it is advisable to make the strips in such a way that they can be readily replaced when worn.

3. The supporting points should be so located that they can be easily reached for cleaning, in order that locations will not be affected by an accumulation of chips or dirt at important points. Adjustable points should be so arranged that dirt and chips will not clog the screws and thus make them difficult to operate. This point in design should receive careful attention when fixtures are designed for use on the vertical turret lathe or vertical boring mill. On machines of the horizontal type, less trouble is likely to be experienced in this respect, because the chips do not tend to fall onto the screws. In either case, however, it is well to provide against trouble from this source.

4. It is frequently desirable to insert hardened steel buttons of uniform height in the jaw screw-holes in order to raise a portion of the work above the tops of the standard jaws, so that the work can be faced or under-cut. These buttons form an excellent three-point support for the work in addition to performing the function already mentioned. Short parallels cut from cold-rolled steel may be used on a vertical turret lathe and are somewhat cheaper than the buttons, but they are open to the objection of becoming easily displaced and lost.

5. When it is necessary to arrange points to act as a vee on long cylindrical surfaces it is good practice to make them so that they can be adjusted to take up wear. This can easily be done by means of headless set-screws with check-nuts to lock them securely in any position; and it is a better construction to place one check-nut on the outside and another one inside, than to have both nuts on one side of the fixture wall. The construction of the fixture will not always permit of using this method, but when it will, very satisfactory results are obtained.

6. Three-point support for the fixture itself may sometimes prove an advantage, especially on fixtures for large work, as a considerable amount of machining time is saved thereby. When three-point support is used in a case of this kind, the clamp screws which hold the fixture in place on the table should be arranged at the points where the supports are placed, and any clamps for the work itself should be as near the same place as possible.

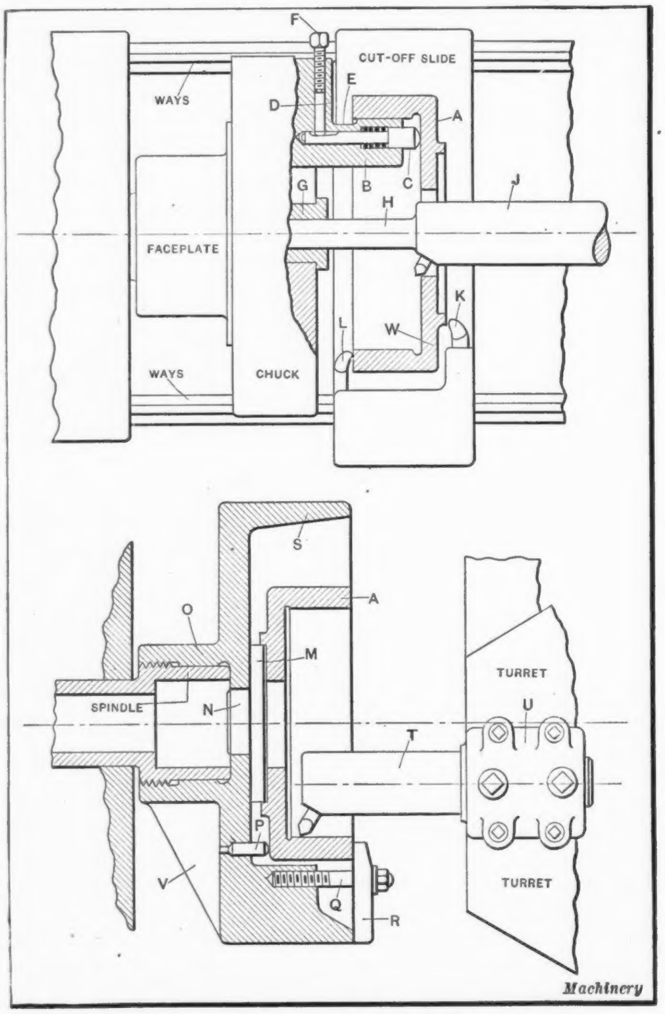

Fig. 3. Application of Three-point Principle in holding a Flywheel while performing Boring and Facing Operations

Some of the other points in connection with the design of fixtures employing the three-point principle are equally applicable to all classes of fixtures for horizontal and vertical turret lathe work. For example, rigidity must always be considered; the cost of the fixture should be, to a certain extent, proportional to the number of pieces to be machined; parts subject to excessive wear should be designed so that they are readily replaceable; and methods of clamping, convenience of operation, and accessibility of all parts should be given careful attention. Other points in design and construction will be noted in specific cases during the progress of this article, and attention will be directed to faults or praiseworthy features.

Three-point Principle Applied to Plain Chucking

The three-point principle may be applied in a number of different ways in handling plain chucking work on a horizontal turret lathe. The work *A* shown in the upper portion of Fig. 1 is a forged steel clutch ring. It is set up on three steel blocks *D* placed against the face of the chuck while the work is gripped by the outside in the jaws *B*. It is a difficult matter to set a piece up in this way unless the blocks *D* are fastened in some way to the chuck. If they are not fastened they will continually move about and become misplaced so that their usefulness will be destroyed. In the instance shown it would have been easy to gain a backing for the work by reversing the jaws and using the tail *C* as a support. As it was necessary to bore the work, however, the projection of the jaw would cause an interference with the boring tool as it passed through, so that this method was not advisable. The bar *E* was used to bore the work while the facing tool *F* on the cross-slide faced the rim. Another method of holding the same piece is shown at the left in the lower part of the illustration, a steel ring *G* being screwed to the face of the chuck by three screws *J*. The three pins *H* are set into the ring at points equidistant from each other and serve as a support. This method is fairly good, but involves the making of the ring and drilling into the face of the chuck for the screw-holes. A still better method is shown in the lower right-hand illustration, in which a special set of jaws *B* is used, each of these having a pin *K* against which the work locates. Clearance is provided by the amount of offset in the pin. The conditions shown in this illustration are as simple as can be conceived of, and as a matter of fact, work as shallow as this is seldom provided with three-point support other than that afforded by the tails of the jaws, unless conditions are similar to those shown.

Three-point Support for a Piece of Electrical Work

The work *A* shown in the upper part of Fig. 2 is a steel casting which is held on an internal cored surface by the special jaws *K* of a three-jawed chuck. One of these jaws is provided with a pin *L* which strikes against the cored surface of the casting, thus giving correct longitudinal location. A

portion of the jaw is cut away at *M* in order to provide for the facing of this end of the casting by the tool *N* on the cut-off slide. Another tool *O* is used for facing the end of the boss, and both of these tools are held in a special tool-holder. A boring-bar *P* in the turret is used to bore the hole simultaneously with the facing operation. In a case of this kind it will be noted that the jaws have a wide surface contact and that the use of three pin supports would not be practicable, unless two of the pins were adjustable. The adjustable feature was deemed unnecessary in this case. The lower portion of the illustration shows the second setting of the work, which is extremely simple. A three-jawed chuck is provided with a set of special jaws *D*, bored at *B* to the diameter of the finished surface of the work and faced at *C* to engage the finished end of the boss. The surfaces used as locating points are finished, thus permitting of this method of procedure; the supporting points do not require any means of adjustment. A bushing *F* is set in the chuck to act as a guide for the pilot of the boring-bar *E*, thus insuring greater rigidity. The tools *G* and *H* are used for boring, and the tool *J* cuts the recess in the end of the work. A method of this kind is applicable to many kinds of work when two finished surfaces at right angles to each other can be used for holding and locating the work, respectively.

Three-point Support used in Chucking a Motor Flywheel

The motor flywheel shown at *A* in the upper part of Fig. 3 is another instance where three-point support is used in connection with chuck jaws. In this case the flywheel is of such a diameter that a single supporting point in one of the jaws would not be sufficient to resist the pressure of the cutting action of the various tools used in machining, so that the use of three supporting points was found necessary. The work is held by the inside in the special jaws *B* which are relieved at *E* to permit the back facing of the rim. The tools *L* and *K* which are held in a special tool-block on the cut-off slide, are used for back facing and finishing the pad; and other tools (not shown) in the turret face the portion *W* of the flywheel. The boring-bar *J* has a pilot *H* which enters the guide bushing *G* in the chuck to give greater accuracy and rigidity. Two of the jaws are provided with spring pins *C* which are released and locked by the action of the screws *F* on the shoes *D*. Attention is called to the manner in which the supporting pins are beveled at their points to prevent any change of position after they have once been locked. The stop-pin in the other jaw (not shown) is fixed in order to give positive longitudinal location of the work. Work of this kind is very frequently located on the three fixed ends of the jaws and gripped by the inside as shown, but when this is done there is always a chance of incorrect holding and possible slippage due to spring of the casting. Sometimes this results in the production of grooves or a wavy surface on the outside of the work.

In the second setting of the work a fixture is used and the point of location is the recess which has been machined in the first setting. This locates the piece on a plug *M* which is shouldered at *N* and fits a hole provided for it in the center of the fixture. The previously machined surface *W* rests on three pins *P* which are of uniform height and so arranged that they leave a slight clearance between the face of the plug *M* and the face of the shoulder on the work. The fixture body *O* is screwed to the spindle and its exterior forms a continuous ring *S* so as to make this surface clean and avoid danger to the operator through projecting lugs, etc. The work is drawn back against the pins *P* by means of the clamps *R* through the medium of the screws *Q*. Work of this kind is frequently held and drawn down onto a continuous finished surface instead of a series of pins. The disadvantage of a continuous surface is that dirt collects upon it and renders locations uncertain unless great care is taken to keep the fixture clean. With an arrangement of pins such as that shown, no dirt can possibly collect and locations are therefore positive. During this setting the turret is set over and the bar *T* used to bore the clutch seat.

Fixture for Irregular Work using the Three-point Principle

The work shown at *A* in Fig. 4 is of such a nature that it cannot be held or located in chuck jaws, so that the provision of a fixture was found necessary. The fixture body *W* is screwed to the spindle and has three fixed locating points *B* set in its face. The casting is located on these points and an adjustable screw *C* is used to give support at a fourth point. Two set-screws *H* are set in lugs *K* on the face of the fixture, thus forming a vee which centers the work. There are four lugs *O* around the exterior of the casting, these lugs being provided for clamping purposes. In setting up the work, the clamp *Q* draws the casting down on the pin *B* when the stud *R* is tightened. The lug *S* and the end of the clamp are beveled so that in addition to clamping the work, they force it over into the vee formed by the set-screws *H*. Two check-nuts *J*, one on each side of the lugs *K*, are provided to secure the screws *H* in any desired position. A driving pin *D* takes the thrust of the cut so that the clamps are not depended upon for driving; and three other clamps *L* are drawn down on the lugs by means of the screws *P*, the ends of these clamps being supported by pins *M*.

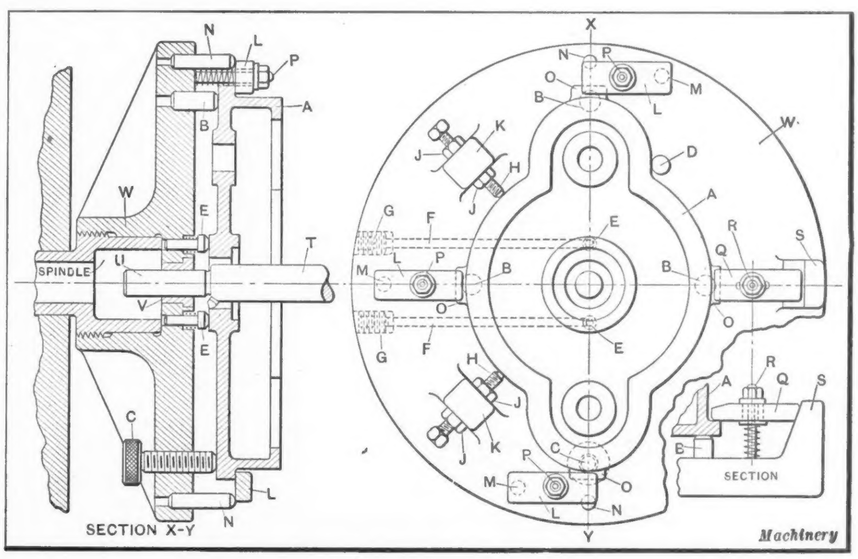

Fig. 4. Fixture employing Three Fixed Locating Points B and One Adjustable Point C

In order to keep the diameter of the fixture down, the two clamps *L* are set so as to economize space, and the pins *N* help to distribute the pressure properly when the clamps are tightened. As the casting is somewhat thin, it is necessary to provide two spring pins at *E* in order to support the center of the work; these are located in position by the plungers *F* which are operated by the hollow set-screws *G*. The section X-Y makes this construction clear. A bushing *V* is set in the center of the fixture and acts as a guide for some of the tools used in machining, one of these tools *T* being shown in position in the work. Although this fixture gave excellent results some care was necessary to see that it was not sprung out of shape by the action of the clamp *Q*, which was tightened first to force the work over into the vee and had an inclination to tip the work slightly away from the opposite stud. This was obviated by tightening the opposite clamp slightly before completing the clamping with *Q*.

Chuck Jaws and Adjustable Points on the Vertical Turret Lathe

It is frequently possible on the vertical turret lathe to make use of adjustable points in connection with chuck jaws for setting up work. An instance of this kind is shown in the upper part of Fig. 5, where the work *A* is centered by the action of the jaws *B*. Raising blocks *D* are tongued at *E* to fit the regular sub-jaws of the table, and the upper jaws are

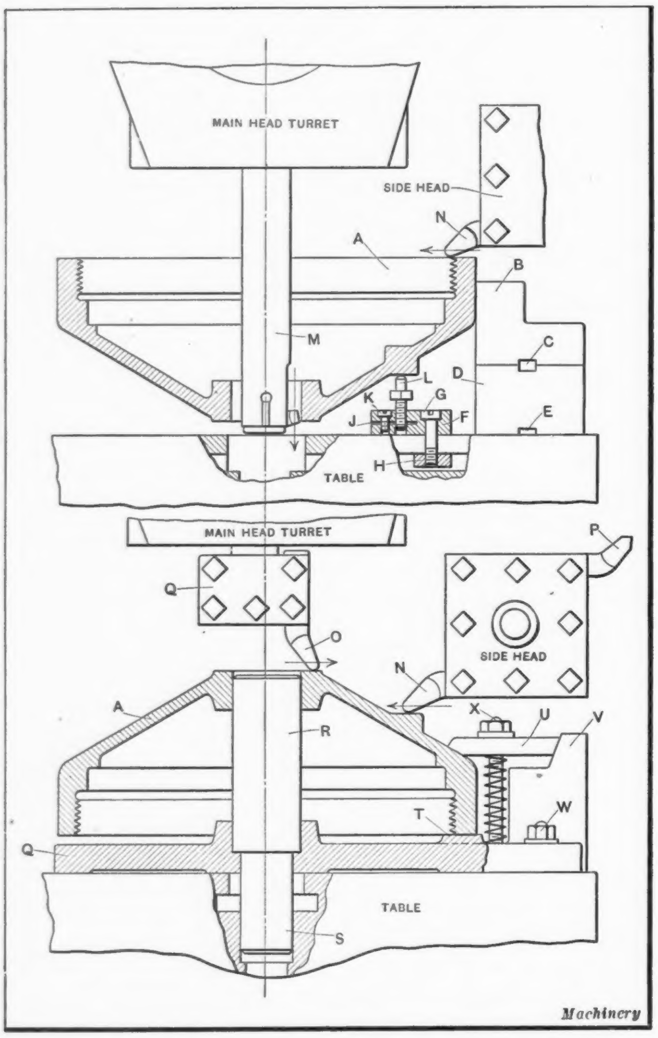

Fig. 5. Use of Adjustable Locating Points in connection with Chuck Jaws for holding Work on Vertical Turret Lathe

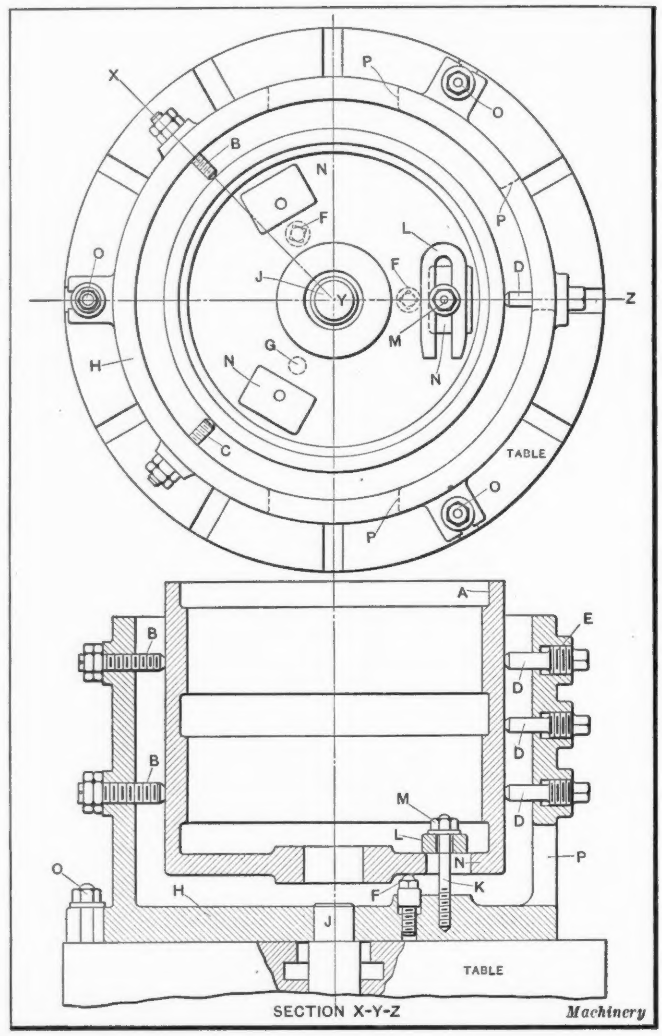

Fig. 6. Fixture for holding Work where both Supporting and Driving Facilities must be of Ample Capacity

keyed to them at *C*. Three special blocks *F* are secured in the desired positions by the screws *G* and shoes *H* in the table slots. The screws *L* are squared up so that a wrench may be used to adjust them, and their upper ends are rounded to form a seat for the casting. The blocks *F* are split at *J* and the screws *K* draw the two sides together and thereby hold the locating points in position. The boring-bar *M* in the main-head and the tool *N* in the side-head are used for boring and facing the casting. In the second setting of the work, a fixture is used having a central stud *R* on which the piece locates, while the lower portion of the stud *S* centers the fixture *Q* on the table. Three pads *T* form a resting place for the previously machined rim of the casting *A* and the clamps *U* are used to draw it down firmly. On account of the beveled exterior of the work, the clamps are also beveled —both where they bear on the casting and also at their rear ends—in order to keep them from pushing back when the pressure is applied. The lugs *V* are beveled to correspond. The fixture is held down on the table by means of the screws at *W* which enter the T-slots in the table. This simple and inexpensive fixture gave excellent results.

Three-point Fixture for a Pot Casting

The fixture shown at *H* in Fig. 6 was arranged to hold the casting *A* which is of large size, instead of using jaws, for the reason that both the supporting and driving facilities were required to be of greater capacity than could be applied by means of jaws. Attention is called to the fact that large castings held in a fixture require considerable clearance between the work and the fixture, because of the variation in size and also on account of the finish allowance that is necessary. Care must therefore be taken to see that the amount of clearance is ample to take care of any condition which might be found. An inch of clearance all around is none too much on a big casting. The pot fixture *H* is centrally located on the table by the plug *J* and is fastened down by the T-bolts *O* in the table slots.

The V-principle is used in locating the work, the set-screws at *B* and *C* serving as locating points. There are two screws at *B* and one at *C*, the latter being located midway vertically between the other two and 90 degrees from them. This is somewhat contrary to the usual custom and in some cases might not be found desirable—for example, when considerable dependence has to be placed on the locating screws to assist in driving the work. In this case, however, ample provision for driving is obtained in the holes *N*. The work is forced over into the vee by the center set-screw *D* of the three shown opposite the vee; and when the casting has been brought up snugly into place, the upper and lower screws *D* are also tightened. Attention is called to the manner in which protection against chips is provided for in the construction of these set-screws, in which no portion of the thread *E* is exposed. The work rests on a fixed point *G* (shown in the upper view) which acts as a positive stop. Two additional points *F* are adjustable by means of a wrench, and their threads are protected from dirt by a cylindrical portion above. The openings *P* in the wall of the fixture allow access for the screws; and the piece is held and driven through the U-clamps *L* which draw it down onto the points by means of the nuts and washers *M* on the studs *K*. The clamps *L* being of U-section are readily removable without requiring the nuts and washers to be taken off. The plan view shows only one clamp in position in order to show this clearly.

Two Methods of Obtaining a Three-point Support on a Hub Casting

The work *A* shown in the upper portion of Fig. 7 is a hub casting of large size, and the method to be described was first suggested in connection with the handling of this work.

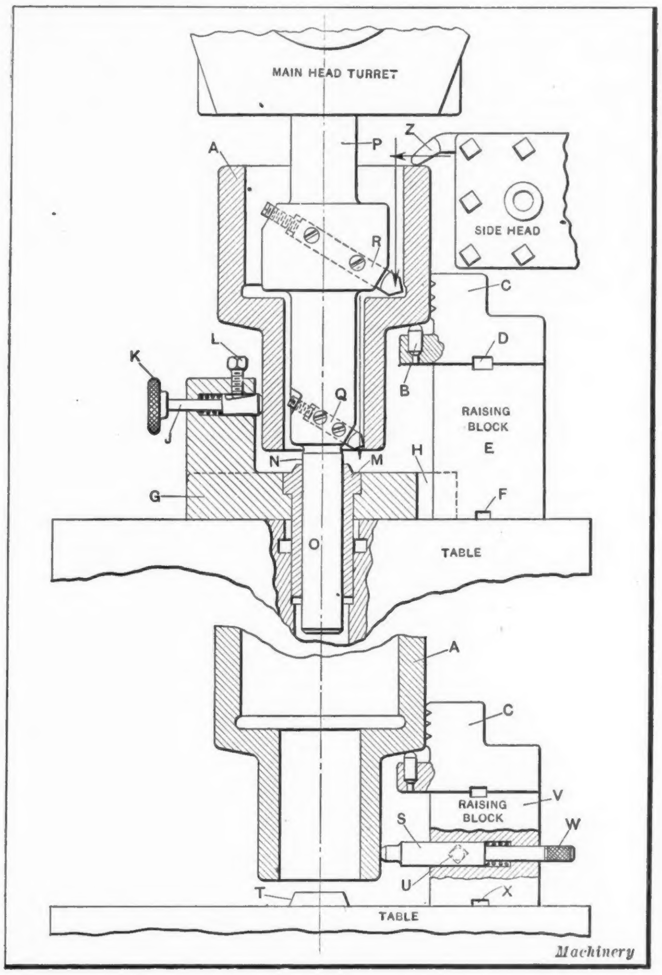

Fig. 7. Original and Improved Methods of holding Large Hub Casting by Three-point Support

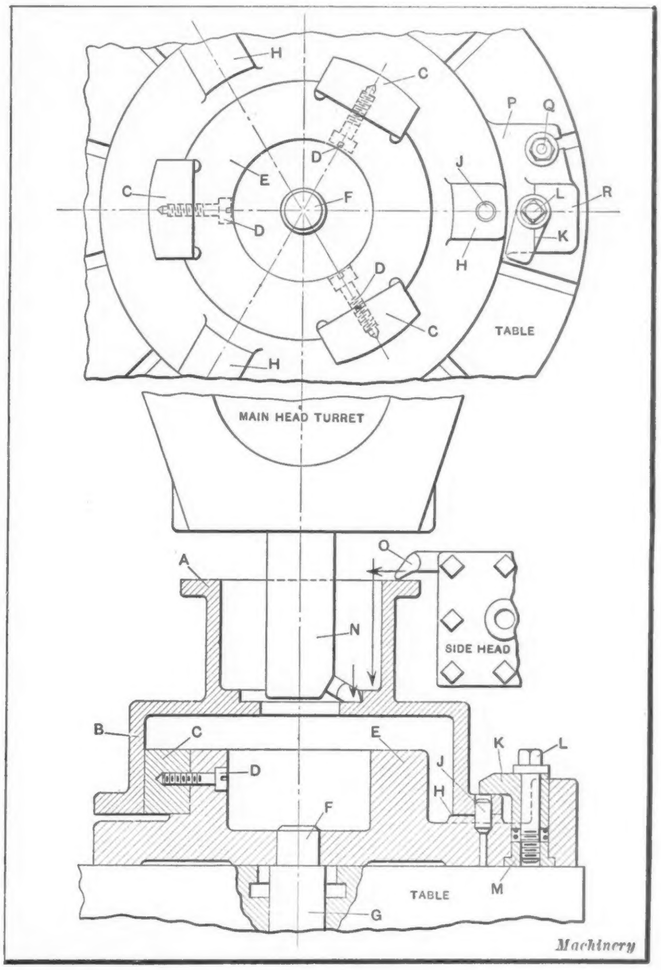

Fig. 8. Fixture for locating Work from Surfaces bored and faced in Previous Operation

The idea was abandoned, however, in favor of the method shown below. In the upper illustration, the jaws *C* are mounted on the raising blocks *E* and tongued to them at *D*, while the raising blocks are tongued and fastened to the sub-jaws of the table at *F*. Three hardened points *B* are set in projections of the upper jaws and the work rests on these points. A supplementary casting *G* is centered on the table by means of the hollow plug *M* which also acts as a guide for the boring-bar pilot *O;* and the upper part of this bushing is beveled as shown, but the edge of the hole is left sharp so that chips will not be drawn down with the bar and tend to destroy it together with the bushing. The base of the fixture is slotted at three points *H* to allow the necessary movement of the jaws; and there are three lugs midway between the jaws on the base, in which the spring pins *J* are carried. After the work has been centered by the jaws, these pins are released and allowed to come into contact with the work; they are then locked by the set-screws *L*. The boring-bar *P* is of the multiple type, having two tools *Q* and *R* for the two inside diameters. Attention is called to the fact that the tool *Z* is carried in the upper part of the side-head instead of the lower; this is done in order to economize on the length of the boring-bar.

As the purpose of three supporting points *J* was simply to steady the work, it was thought that a simpler design would answer all purposes, and the previous scheme was therefore abandoned in favor of the one shown in the lower part of Fig. 7. In this case the bushing *T* is used directly in the center hole of the table and the boring-bar is made correspondingly shorter. The raising blocks *V* are also lower than in the previous case, and are keyed to the sub-jaws at *X* in the same manner. The construction of the jaws *C* is identical in both cases. Three spring plungers *S* with knurled ends *W* are inserted in the jaws and tightened in any desired position by the set-screws *U*. This method is much simpler than the other and possesses the added advantages of being both cheaper and more efficient.

Three-point Location for a Large Casting

The work illustrated at *A* in Fig. 8 has been partially bored and faced in a previous setting; and in the setting shown, it is necessary to work from the previously finished surfaces. The base casting *E* is slotted to receive the three steel locating jaws *C* on which the finished surface *B* locates. These jaws are held in place by the screws *D* and are carefully finished after being drawn into position. The base is centered by the plug *F* in the table hole *G*, and is held down by the screws *Q* in the lugs *P*, one of which is shown in the plan view. Three pads *H* are finished to support the flange and a driver *J* is inserted in one of these pads. The work is clamped by means of the hook-bolts *K* in order to keep the diameter of the fixture as small as possible; and a cap-screw *L* passes through the hook-bolt and enters the bushings *M* into which it is threaded. Attention is called to the manner in which the hook-bolt is backed up by the lug *R* so that it will not become distorted when under strain. The boring-bar *N* in the main-head turret, and the tool *O* in the side-head, are indicated in order to show the method of machining. On large diameter work, such as the piece shown, relieved points of location are much better because there is less friction in assembling or placing the piece in position. A series of pads in place of a continuous surface is also a better construction, because a fixture so designed is much easier to keep clean.

The Three-point Principle Applied to a Four-jawed Table

The forging *A* shown in the upper portion of Fig. 9 is a large bevel gear blank, and it was desired to machine this piece on a vertical turret lathe having a four-jawed table, for the reason that the machines having three-jawed tables were overcrowded with work. A cast-iron locator *B*, having three raised strips *F* inclined at 30 degrees to the center line of the table, was pinned at *D* to the stem *E* held in the main-head turret. This was brought down into the hole *C*, thereby approximately centering the work. Three of the jaws *H*

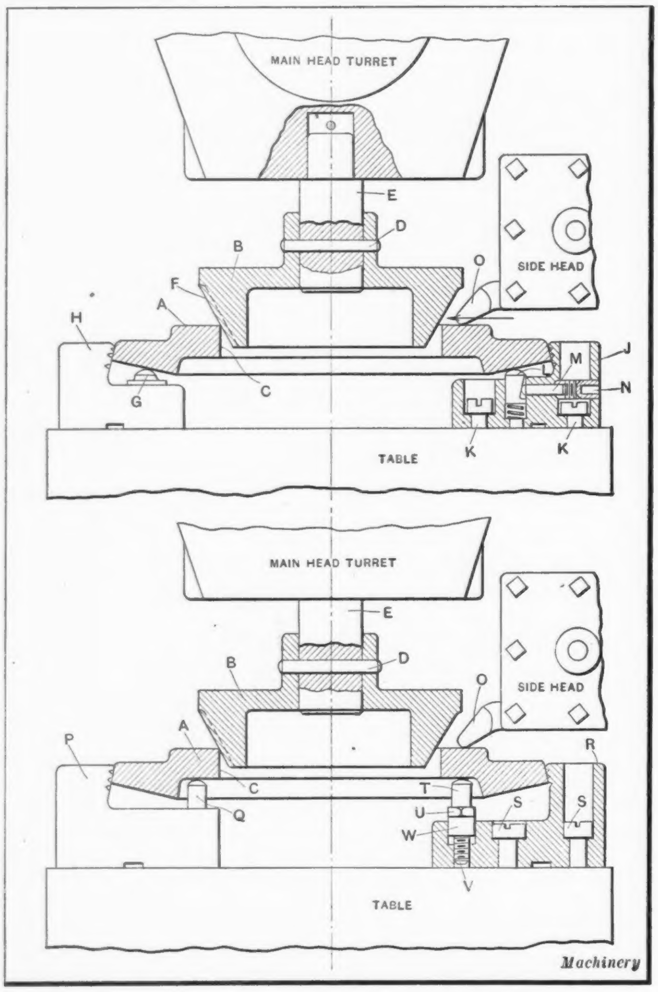

Fig. 9. Two Methods of holding Bevel Gear Blank; the Method shown above gave Trouble through Slippage of Supporting Pins on Beveled Surface

were then brought up on the work rather lightly, the pins *G* in the jaw screw-holes serving as supports to engage the beveled portion of the gear blank. The fourth jaw *J* was then brought up and the spring pin *L* allowed to come into contact with the beveled surface of the work, after which it was locked by the shoe *M* and the hollow set-screw *N*. The two screws *K* were used to hold the jaw in position on the sub-jaw of the table. The side-head tool *O* is shown in position for facing the back of the gear. This arrangement was entirely unsatisfactory due to the "cocking" of the gear resulting from movement of the pins *G* along the beveled surface when tightening the jaws. In addition to this there was more or less slippage of the pin *L* on account of the pressure of the cut. The improved design of a fixture for handling this work is shown in the lower portion of Fig. 9, in which the same method of centering is used, but the jaws are arranged differently. The three jaws *P* have locating pins *Q* of equal height, on which rests the relieved portion of the gear blank which is not beveled. The fourth jaw *R* is held down on the sub-jaw by the two screws *S* and has an adjustable point *T* which is threaded at the lower end and squared up at *U* so that a wrench may be used upon it. Attention is called to the fact that the portion *W* of the adjustable point is larger than the screw and therefore protects it from being clogged with chips or dirt. This method was much more satisfactory than the one previously described.

Double Three-point Locating Device

A somewhat peculiar arrangement is that shown in Fig. 10 for holding a piece of work *A* by the interior cored surface. The base *B* is made of cast iron and is centered on the table by means of the hollow plug *C*. It is held down in the usual manner by screws *D* which enter shoes in the table T-slots. The upper portion of the fixture *E* fits a circular tongue *F* on the base, to which it is screwed by the screws *G*. The upper portion *E* is slotted to receive the jaws *N* and *O*, and there are three of each of these jaws set 120 degrees apart. The upper portion of the fixture *E* is made separate in order to facilitate the machining of these slots. Two cylindrical cams *H* and *J* control the radial movements of the jaws by means of the screw *K* which is threaded with a coarse pitch left-hand thread in the lower cam and a right-hand thread in the upper cam. The upper end of the rod is squared at *L* and is operated by a socket wrench *M*. In order to prevent the entry of chips and dirt into the mechanism a felt washer *S* is fastened to the upper cam; and steel cover plate *R* is placed on top of the fixture and held in place by screws. The hardened steel pin *T* strikes against the inner cored surface and locates the piece vertically. Slots are cut in the upper portion of the fixture *E* to allow the insertion of the flat springs *Q* which throw the jaws back into position upon withdrawing them from the work; and a sheet steel cover plate *P* keeps the dirt out of these slots. The cams and screw are supported by the coil spring shown below the lower cam, and the action of the cams is limited by the screws *U* which enter slots in the cams. These screws also serve to prevent the revolution of the cams. A combination boring and reaming bar *W* is used for boring and reaming the hole while the outside surfaces are machined by various tools in the side-head, one of these being shown at *V*.

In the construction of this device it will be noted that although six points or jaws are used for locating, the arrangement is such that they all bear against the inside of the casting with an equal amount of pressure, at the same time centering the work from the cored interior. As the right and left screw on the rod *K* is rotated, the two cams float vertically so that the pressure on the jaws is equalized. A device of this kind is useful in many instances when work is to be held from an internal cored surface. From the instances given during the progress of this article, the importance of three-point support can be readily seen, and the examples shown, although purposely selected for their simplicity, cover the majority of cases met with in general practice.

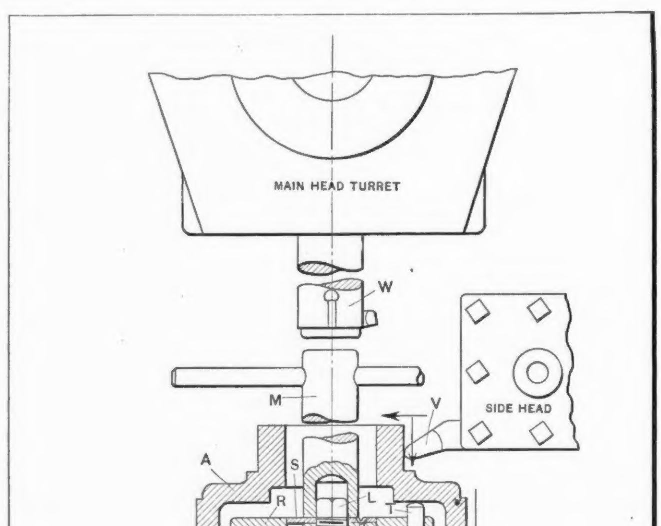

Fig. 10. Method of holding a Piece of Work by an Interior Cored Surface

MANUAL TRAINING VS. TRADE TRAINING

BY E. H. FISH*

How may we distinguish between manual training and trade training? It is not enough to say that the leading purpose of manual training is cultural while that of trade training is vocational. There must be some way in which we can tell whether we are in a manual training high school or in a trade school without depending on the sign over the door.

It does not depend on cost of equipment, for some manual training schools have very fine and elaborate equipment, and a trade can often be taught with a very meager one. It does not depend on the quality of the equipment, for while good quality is desirable in one school it is no less desirable in the other. It does not depend on the amount of money spent for instruction. It does not depend on hours of shop practice, for the hours given to manual training are enough for its purpose, but more hours of the same kind of practice would not make a journeyman. It does not depend on housing, nor on materials, nor on exercises, nor on related or non-related study. On what then does it depend? No brief direct answer to this question is possible. The most concise answer would be to say that it depends on the spirit in which the work is undertaken—that manual training is amateurish and trade training professional; but that answer is not complete without further definition.

The spirit of amateurishness shows itself in manual training in the limited amount of work done in a given time, which is very properly justified because the greatest educational value of the various projects must be gotten from them. It shows itself also in the variation of its methods from those of the professional tradesman. For example, a favorite project is a roller towel-holder which, in itself, is an abomination because it suggests a towel which will be used until it is uniformly black all over. In manual training the roller is planed square, octagon, and many-gon until it can be sandpapered into a pretty good cylinder. In a shop a small boy turns these out by the bushel with a back-knife lathe while the manual training boy makes one. The lathe-made rollers are nearer round and straight, not because they need be, but because it is quicker to do it that way. There is not as much educational value to be had per dollar's worth of lumber the manufacturer's way as the manual training way, but the boy who has made a roller towel fixture with a plane is not worth as much in industry as the boy who has made a thousand or even one by means of a lathe.

Amateurishness shows itself in the failure to continue training until work is done habitually well. One piece well made is accepted as evidence that the pupil could continue to go on and make others equally well, which is by no means true. A workman could not possibly go on day after day putting the close mental attention upon his work that was necessary for the first job. He goes through three stages: the first is when he begins a new operation and is careful to follow directions because he is afraid he will spoil work. During this he is slow. The second is one of self-confidence when he speeds up and spoils work; and the third, is one of sub-consciousness when his work is done rapidly and well without any considerable conscious thought. If there were not this last stage most of us would land in the insane asylum.

Professionalism then requires an abundance of work of such a character as to give plenty of repetition with only a gradual demand for a growing intellectual attainment. It requires the use of the methods to be followed in the trade to a great extent and it requires the attainment, as a matter of habit, of skill of a commercial standard or better.

I realize that it shocks many good souls to walk into a school shop and see boys running a lathe with a hundred or more bolts or toolposts or screws or collars or what-not stacked up beside them. There is a feeling that when a boy has done a good job once he should be promoted to the next. It will not do, for boys are boys and they are boys because they have not matured. When they mature they will be men regardless of age. When a mature man is given a single shaft to make, it may be that he will have learned all that is to be learned about it if he makes one and does a good job, but a boy very seldom does the fifth or sixth piece as well as he does the second or third.

Again, trade training must of necessity train in the ways things are done for profit and that means in many ways. For example, in a shop where a few short studs are needed they are centered, turned and threaded on a lathe; where larger quantities are needed they are made in a hand screw machine, and where large quantities are used they are made on an automatic. The first is the machine shop method, the second is a manufacturing method, and the last a factory method. The first two should be taught to a machinist, the last only in such communities as have industries where the method is used.

Often it is desirable that boys should be taught an obsolete way of doing certain things because it is fundamental and because they will understand the modern way much more thoroughly if they know the old way. It should be borne in mind that a school shop must train boys so that they will be quick to see ways in which work may be done, for no shop, in school or out, can train a boy or man in all the things which he may be called upon to do. Every new job in a shop is like an original problem in geometry; it requires a new combination of simple fundamental processes for its completion. If the workman can apply these fundamentals he has a trade, if he cannot he must be content to remain an operative.

* Address: 18 Vassar St., Worcester, Mass.

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PROFIT SHARING SYSTEM, CLEVELAND TWIST DRILL CO.

The Cleveland Twist Drill Co., Cleveland, Ohio, has put into effect a system of profit sharing with its employes which provides as follows:

1. Before any profits are divided with employes, the stockholders shall receive eight per cent per annum.

2. When the above eight per cent has been paid to the stockholders in any calendar year, all cash dividends subsequently declared in that year will be divided between the stockholders on the amount of their stock interest and the employes on the amount of the salary or wages received by them during the twelve months ending June 30 of that year as follows: (A) Employes who have been continuously in the service of the company for at least two years prior to July 1 will receive dividends at the same rate as the stockholders. (B) Employes who have been continuously in the service of the company for more than one year and less than two years prior to July 1 will get three-quarters of that rate. (C) Employes who have served continuously for less than one year will get one-half the rate of the stockholders. (D) Dividends that have accrued will be distributed to employes once a year in December except that dividends for the year 1915 will be distributed January, 1916.

3. No person will be entitled to a share of these dividends unless a bona fide employe of the company at the time of their distribution, except that employes laid off owing to lack of work or sickness will be entitled to the dividends accruing in any year on the wages earned by them during the twelve months prior to June 30 of that year.

4. Employes voluntarily leaving the service of the company or dismissed or discharged will forfeit their right to any accrued dividends.

5. Any employe who may receive a commission from the company or any share in profits other than the profits shared in this plan, except through dividends of stock, if a stockholder, shall thereby be rendered ineligible to receive dividends under this plan.

6. All employes except those entered in the three preceding sections shall be eligible to share in the profits under this plan.

7. The above plan for division of profit is absolutely voluntary on the part of the company and is in no sense a contract. The right is therefore reserved by the directors to make at any time such changes in the plan as they may consider desirable for the best interests of the organization. The fact that any employe is receiving the dividends in this profit sharing plan shall not deprive the company of the right at any time to discharge the employe and thereby terminate his participation under the plan, nor shall any employe acquire any right thereunder to any accounting by the company concerning its business or profits.

* * *

The man who says "It can't be done," is always being interrupted by somebody doing it.

TURNING "DIFFERENTIAL SPIDERS"

BY CHESTER L. LUCAS*

In the manufacture of differential gears for automobiles, one of the principal parts of the work is the "spider," so called because of the four radiating arms upon which the bevel pinions are mounted. These "spiders" are drop-forgings, and one of the machining operations is the turning of the four arms. At the New Process Gear Corporation's plant in Syracuse, N. Y., this turning operation has been reduced to its lowest terms by the automatic turning lathe that has been built for the company by the Porter-Cable Machine Co. of Syracuse, N. Y. This machine has many points in common with the standard Porter-Cable manufacturing lathe, but the general appearance of the new machine is different, because of its two tailstocks and vertical position.

This machine is shown as a whole in Fig. 1; a view of the turning operation may be seen in Fig. 2; and in Fig. 3 the clutch operating mechanism for stopping the machine after each operation is illustrated. Before coming to this machine to be turned, the forgings are centered at the ends of the arms. In Fig. 2 the rough spider may be seen at *A* ready to be turned. On the bed and at the right of this illustration some of the spiders may be seen. The lathe centers upon which

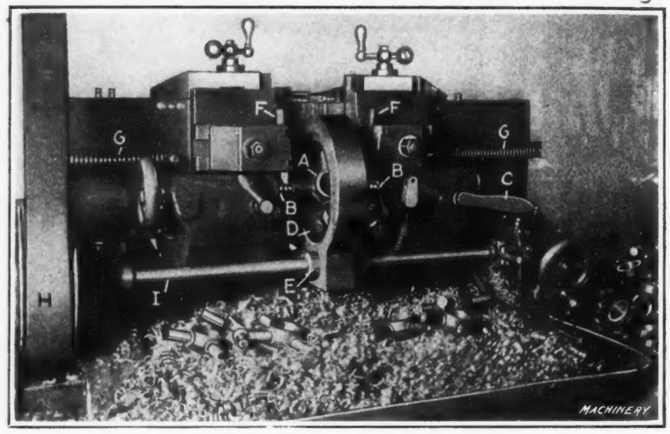

Fig. 2. Lathe in Operation

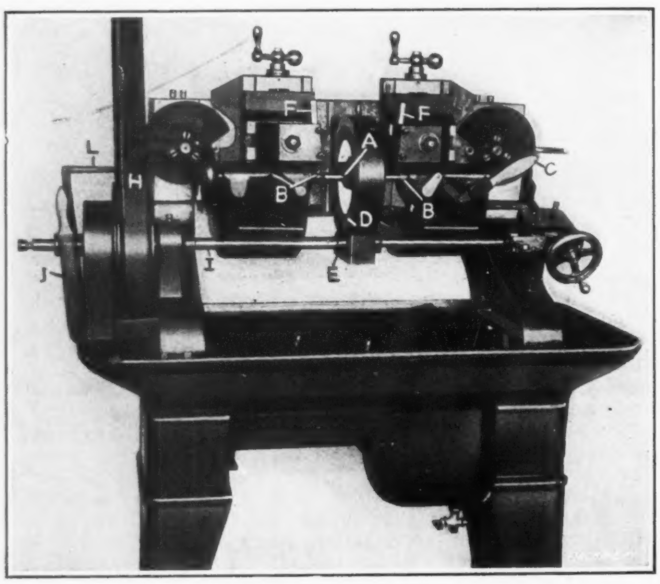

Fig. 1. Semi-automatic Lathe for turning "Spiders"

the work is held are shown at *B* and a quick-acting lever *C* is for operating the right-hand center quickly. The drive for the work is furnished by ring *D* that is driven through teeth on its outer surface that mesh with those of pinion *E* on the driving shaft. A pin inside of this ring acts as a driver against one of the arms of the spider. The cutting is done with two tools *F* that are mounted in the two carriages. For adjusting the position of the tools, the carriages are provided with cross-slides; thus any depth of cut is quickly obtained.

The carriages are cam-actuated, as may be best seen in Fig. 1 which was photographed with the cam guards removed. The rises of the cams govern the rate of advance. The carriages travel in opposite directions, each starting its cut from the end of the arm upon which it is to work. After the cuts have been taken, the carriages are returned to their starting positions by means of the spiral springs *G*, shown in Fig. 2. The drive of the machine is through the main pulley *H*, and this is connected by a clutch to the main driving shaft *I*. An angular shaft at the extreme right-hand end of the machine is rotated by driving shaft *I*, and transmits motion to a longitudinal shaft back of the machine that runs parallel with the main shaft. The longitudinal shaft is not shown in the illustrations, but it carries worms that mesh with worm-wheels on the two cam-shafts and thus transmits motion to the two cams.

The starting of the machine is accomplished through the hand clutch lever *J* at the left-hand end of the machine. After the spider has been put on the centers, this clutch is thrown by hand and the machine commences its work. The two cuts progress until they reach the hub of the spider. By this time the cams have reached the limit of their rises, and as soon as the drops in the cams are reached, the carriages are drawn back by springs *G*. There is no shock to the carriage return movements, as the cam-drops are not quite radial. The receding action of the left-hand carriage results in throwing the clutch-operating lever and stopping the machine. The manner in which this is accomplished is shown by the two views in Fig. 3.

Referring to the view at the left, the extreme left end of one of the carriages is shown at the time of returning. On the under side of the carriage a block *K* is bolted, and as the carriage moves back, the edge of this block hits the end of clutch lever rod *L*. The clutch lever rod is guided in a bracket *M*, and a leaf spring forces the rod against the under face of the bracket. There is a pin *N* against which the upper face of the clutch rod contacts, and as the rod is pushed backward by block *K* on the carriage, an angular step on its upper face causes the rod to be depressed slightly as it passes the pin. This action permits block *K* to finally clear its contact with rod *L* and the action is thus stopped. It is the movement of rod *L* and its action on the clutch operating lever that throws out the clutch and causes the main driving shaft of the machine to cease rotating until the operator has thrown the clutch in again by hand.

Two settings of each spider are necessary to complete the turnings on the four arms. The production of the machine is very high, it being an average nine-hour day's work for an operator to produce 375 spiders, or a total of 1500 turned arms. An idea of the way the chips accumulate may be gathered from Fig. 2, and it was to permit gravity to remove the chips that the lathe was mounted in a vertical position rather than in the conventional way. Had the lathe been operated in the usual way, the space between the work and the two approaching carriages would frequently have become choked with chips and the operation impeded.

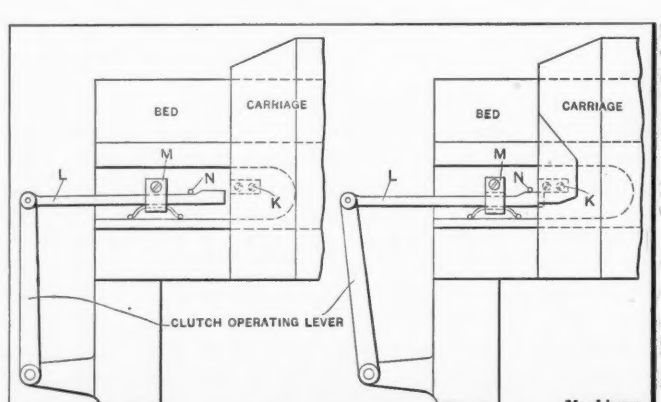

Fig. 3. Mechanism that throws out Clutch

* Associate Editor of MACHINERY.

THE HEAT-TREATMENT OF DROP-FORGING DIES

BY FRANK E. MERRIAM*

The heat-treatment of drop-forging dies depends largely upon the material of which the die is composed and this, in turn, is determined by the nature of the forging which is to be made and the severity of the requirements. As an illustration, consider the die for a forging requiring to be finished all over or having portions which need not bear a definite relation to other portions even though not machined. In this case it is evident that a variation of 1/16 inch, or even more, is not likely to be regarded as excessive and therefore a similar error may exist in the die, either from wear, distortion in heat-treatment or in machining.

On the other hand, consider a forging of which certain portions are not to be machined and yet must maintain definite relations to adjacent portions. In the case of forgings of this kind the variation allowed is sometimes not over plus or minus 0.005 to 0.010 inch. Of these two cases it is evident that in the first a high grade of steel is not necessary and the heat-treatment will necessarily be simple. In the second case the very best material must be used in order to secure the required degree of hardness, together with suitable toughness. In this case very great care must be used in the heat-treatment in order to bring out the best there is in the steel and combine its good qualities in the proper manner. This article will describe a method of heat-treating dies of the second class.

A suitable grade of steel is high-quality crucible steel of approximately the following analysis: carbon, 0.75 per cent; manganese, 0.25 per cent; silicon, 0.15 per cent; sulphur, 0.015 per cent; and phosphorus, 0.015 per cent. The decalescent point of this steel is between 1350 and 1360 degrees F., and in eight-inch cubes, it will harden properly at 1450 degrees F. This size die-block is common, and the heat-treatment described below has particular reference to it. A die for this purpose must evidently be machined carefully, heat-treated to wear well, and distorted as little as possible, besides being tough enough not to break. The necessary operations for heat-treating the dies are as follows: annealing; preheating; heating for hardening; quenching; preliminary hardness test; drawing; and final hardness test. These operations and the apparatus used will be taken up in detail.

The annealing is similar to that of ordinary tool steel. The blocks are placed in a furnace, slowly heated to 1400 degrees F. and then allowed to cool slowly. The cooling takes place in the furnace, which has all openings closed with fire-clay, after the proper temperature is attained. During annealing care must be taken not to allow the steel to soak long at the maximum temperature. No special care need be taken to prevent scaling, because machining takes place afterward, removing all the decarbonized surface.

Preliminary to heating for hardening, the dies are preheated in front of the open door of the hardening furnace until they reach a temperature of 800 to 900 degrees F., which should be in two to four hours if the furnace is at approximately 1000 degrees F. A good practice is to start this operation in the evening and allow the dies to warm all night. In case the furnace must be used for other work during the preheating, the dies may be placed on the shelf in front of the door, but when the die is finally placed inside, the furnace must be brought to a very low heat. The purpose of preheating is to avoid raising the temperature of the die rapidly from the lower temperature, since such procedure is almost certain to result in cracking. The above methods are recommended because they are more certain to be slow than placing the die in a newly fired furnace.

After preheating, the dies are placed in the furnace and heated for seven to seven and a half hours, the temperature being gradually increased to 1450 degrees F. When this temperature has been reached the heat is maintained for thirty to forty-five minutes. After this, the die is removed from the furnace and immediately quenched. During the heating an accurate check should be kept not only on the actual temperature but on the rate of increase as well. This can be done by means of recording and indicating pyrometers connected to the same couple and placed close to the die. The pyrometer may be of the base-metal, low-resistance, or rare-metal, high-resistance type. Suitable openings should be provided in the furnace so that the temperature may be taken at various points if desired. To insure uniform heating the die should be frequently turned, thus averaging any slight temperature differences.

Since the die is now completely finished as far as machining is concerned, it is necessary to prevent scaling as far as possible. This is entirely a matter of regulating the air entering the furnace for combustion; the small quantity that enters around the door, burners, etc., is negligible. Proper air regulation can be obtained only by close attention to the burners and the interior of the furnace. There is certain to be some free oxygen in the furnace even with the most careful attention, and to take care of this several lumps of coke should be used which will combine with the oxygen and prevent scaling of the die. By observing these two precautions, the dies may be heat-treated without causing more than a discoloration, which is easily removed with abrasive cloth.

The quenching consists of sinking the die about three inches, face downward, in water and playing a spray on the forms. This method leaves the back of the die tough and the greatest hardness at the form and on the face, where it is most necessary. Cooling in this manner, however, creates a tendency to warp the die face, and to prevent this, a small quantity of water should be poured on the center of the back to induce more even cooling. This will prevent a distortion of more than 0.005 to 0.010 inch in the alignment of the face. Any distortion of the back can be easily corrected by grinding. The cooling tank should be sufficiently large to make certain that the water does not become too warm for rapid cooling and should have two bars suspended at the proper distance below the water surface to carry the die while it is cooling. The spray consists of a perforated pipe suspended just beneath the bars and connected to a water supply at considerable pressure. After the die has become sufficiently cool to handle, a scleroscopic test is made at several points close to the forms. The die must show not less than 98, since this represents the condition of full hardness. A file should also be used, as both tests are needed to determine whether the steel has been over- or under-heated. Such matters as over- or under-heating and decarbonization of the surface are easily detected by these tests.

After proper hardening it is necessary to draw or temper in order to give sufficient strength, though it will be at the sacrifice of hardness. The drawing should be done without delay after the die has been quenched. This operation can be readily performed by placing the die with the back to an open furnace door, or in melted lead, and allowing the heat to penetrate gradually until the face is of the proper hardness and toughness. For first-class work this operation requires four to five hours. The extent to which the die must be drawn is originally determined by experiment, and gaged by the scleroscope so that the operation may be repeated at any time. The temper colors or oxides can be used instead of the scleroscope, but this method requires a great deal of skill and experience. The temper colors, however, are useful for indicating the progress of the drawing and to indicate when to make scleroscopic tests. The proper hardness will be about 80 to 82. To make certain that the die will not be harder or softer than this when it is cold, it is necessary to make an allowance for the heated condition. This allowance must be determined by experiment, which has shown in this case that, with the steel fully hardened, to secure a final hardness of 80 to 85 the die must be 76 to 78 hard while still warm. When the die has attained this hardness, it is quenched to prevent further drawing.

One of the most difficult determinations is the time required to heat a given size die-block properly. This can be determined only by experience, since no two furnaces heat alike and different grades and types of steel vary as to the rapidity with which they can be heated. About the only guide is the appearance of the steel, which gradually comes to assume a

* Address: 915 Summers St., Dayton, Ohio.

uniform color throughout, thus indicating that it is thoroughly heated. When a satisfactory condition has once been found it can easily be repeated by heating for the same length of time and in the manner indicated by the recording pyrometer record. Care should be exercised to avoid keeping the die at the hardening heat unnecessarily long. The pyrometers should be frequently checked in order to detect any errors and thus prevent spoiling the work. A pyrometer used continuously at 1450 to 1500 degrees F. should be checked at least twice a week and the couples should be examined even oftener, since they are particularly prone to deterioration. The instruments should be closely watched in order to detect any sticking of the movement. The best way to calibrate is by a master pyrometer which can be occasionally checked at a standardizing laboratory. Another and quicker way is to check the decalescent point of a piece of steel which has been standardized for this purpose. To make this test it is necessary to place the couple of the pyrometer to be tested in intimate contact with the test piece, apply an increasing heat, and observe where the halt occurs. If the heating is not too rapid and ordinary tool steel is used, this point can be readily observed. This, of course, calibrates but one point, but if this point is chosen near the temperature at which the pyrometer is to be used, it will be sufficient to detect any ordinary error. The scleroscope, too, must be calibrated occasionally with the standard test piece, since dust in the tube or rusting of the hammer will cause it to read low and thus upset all the tests.

The method and data of heat-treating drop-forging dies as outlined above was developed by the writer and several others, and has been successfully used for treating a great many dies for difficult forging work.

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DUTY ON DENTAL TWEEZERS

BY JULES CHOPAK, JR.*

The Secretary of the Treasury at Washington, D. C., in a letter of December 23 to the Collector of Customs, has directed that, in future, duty to be taken on certain dental tweezers will be 20 per cent instead of 30 per cent. The tweezers in question are riveted together at one end and do not have two lever handles working on a pivot.

The Philadelphia customs collector was of the opinion that the proper duty to be collected was 30 per cent under Paragraph 166 of the present tariff as "nippers and pliers of all kinds," as his interpretation of certain decisions of the board of general appraisers. The New York collector was not of that opinion, necessitating the rendering of the above decision by the Secretary of the Treasury.

It seems that in the board decisions, nippers and pliers were defined as "two lever handles working on a pivot." The Treasury Department had previously decided that "nippers and pliers covered articles having two lever handles working on a pivot which operate two cutting, gripping or pinching jaws or blades." In another case, the board decided that forceps, clamps, tweezers, needle holders, etc., were dutiable at the higher rate as pliers. Whether or not the tweezers in that case were like these is not apparent.

The sole question is if such tweezers as are subject to this decision are "nippers" and "pliers" within the common or trade understanding of these terms. If they are and satisfactory evidence is produced to the secretary, he will probably change his decision again, and direct that the higher duty be taken.

The common understanding of what constitutes nippers and pliers is the definition that appears in dictionaries and textbooks. The trade understanding is what wholesale dealers in the United States called this merchandise in their wholesale transactions before October, 1913, *i. e.*, if there was a class of goods known as "nippers" or "pliers," and if these tweezers came within that class. In the event that these articles are not nippers or pliers, then the 20 per cent duty should stand under the only other classification in the tariff for "articles or wares, composed wholly or in chief value of metal, not plated with gold or silver, whether partly or wholly manufactured."

* Customs Lawyer, 29 Broadway, New York City.

THE RELATION OF DUCTILITY TO ELONGATION

BY HUGO FRIEDMANN*

The percentage of elongation determined in making a tensile test is generally supposed to give a fair idea of the ductility of the material, and in many cases this relation of elongation to ductility is very marked. For instance, soft annealed copper, which is noted for its high ductility, has an elongation of 40 to 45 per cent in 8 inches. Cast iron, on the other hand, is the best example of the opposite condition; this metal is entirely lacking in ductility and breaks in the tensile test without even being stretched. Another proof of the supposed relation between elongation and

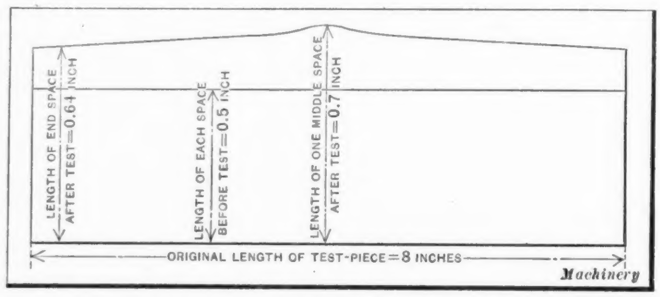

Fig. 1. Result of Test conducted to determine Local Distribution of Elongation in a Test Piece of Hot-rolled Brass

ductility may be seen in the change of properties produced by cold working. Even such metals as copper and aluminum lose a great deal of their ductility by such treatment, and at the same time the amount of elongation is correspondingly reduced. Thus the elongation of thin hard-rolled copper may become as low as 4 per cent. The ductility of brass is so rapidly decreased by mechanical treatment that it has to be annealed after almost every process. This change of properties is likewise accompanied by a corresponding lowering of the elongation, as for example, from 35 to 15 per cent in one commonly used brass mixture.

The same figures, however, furnish evidence that there is at least no strict proportional relationship between ductility and elongation, for the drawing of copper may be repeated without any limit, even after the lowest value of elongation has been reached; whereas it becomes practically impossible to handle the brass previously referred to when the elongation is several times higher than that of the hard copper. This is only one example, taken from common practice, that should caution one against the use of elongation figures in judging the ductility of any metal. By testing various materials which generally receive less attention, plenty of additional evidence may be discovered to verify the truth of this objection. Thus a special kind of brass has been investigated, which shows extremely striking properties. The

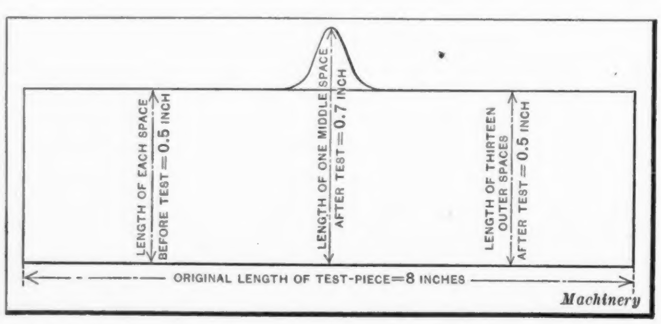

Fig. 2. Result of Test to determine Local Distribution of Elongation in a Test Piece of Cold-rolled Copper

sample was sheet brass about 1/8 inch in thickness, hot-rolled from a mixture containing 57 per cent of copper. It was made of a rather poor raw material containing a large amount of scrap. The ultimate strength was 66,000 pounds per square inch and the elongation 24 per cent, which, although not very high, certainly could not be called low. It

* Address: 5484 Kenwood Ave., Chicago, Ill.

seems to indicate, therefore, a moderately tough material. As a matter of fact, however, the sheet was as brittle as glass, and if the slightest marks were traced with a chisel, a light blow would cause the fracture to follow these lines. For the same reason the test-bars had to be handled with the utmost care. The gage length had to be marked with pencil only, for if scratched with a steel pin the bar broke at these very scratches under a low load. This peculiar material proves most forcibly that a fair value of elongation may co-exist with the lowest degree of ductility and malleability.

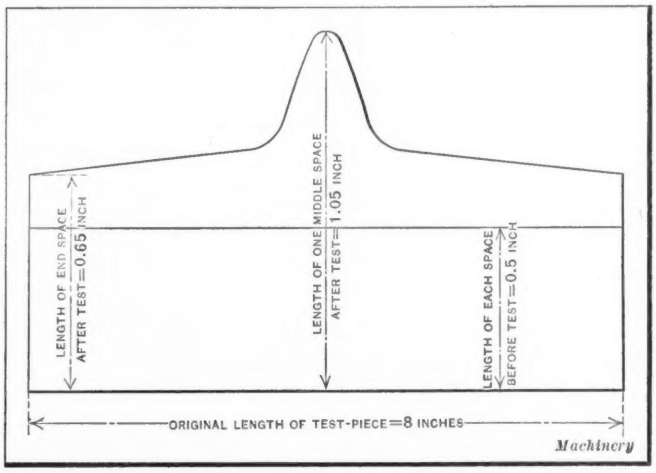

Fig. 3. Same Test conducted on Sample shown in Fig. 2, after annealing Metal

Test pieces of the same material, however, show another peculiarity that appears to be in closer relation to the true properties of the metal than the commonly used value of elongation which is determined as the average for the whole length of the test piece. This peculiarity is found in the local distribution of the lengthening. In order to investigate this condition, the length of an 8-inch test piece was divided into sixteen equal spaces of ½ inch before applying the load; and after the test had been completed, the new distances between the marks were measured, the results being shown in Fig. 1. In order to appreciate the peculiar character of this curve it must be compared with those developed from the tests of other metals. Fig. 2 shows the lengthening of a test piece taken from a cold-rolled copper sheet with only 3.8 per cent elongation; and Fig. 3 shows the results of a test of the same material after annealing. The difference between the latter curves and the curve shown in Fig. 1 is very striking. The brass sheet shows a nearly uniform elongation for the entire length, whereas both copper samples are characterized by a very distinct maximum at the breaking point. Corresponding to these diagrams, the broken copper

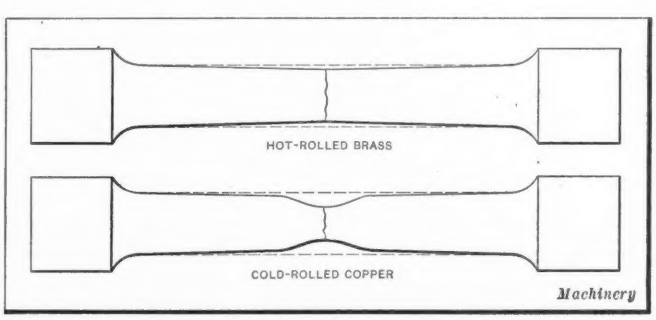

Fig. 4. Outline of Broken Brass and Copper Test-bars, showing Reduction of Cross-sectional Area at Breaking Point

bars showed the usual outlines, as shown in Fig. 4; the brass bars, on the other hand, had nearly parallel edges as before the test. In other words, their distance was reduced uniformly throughout the whole length.

As the high value of local elongation obviously corresponds to the reduction of area at the point of fracture, it might be assumed that the percentage of reduction is the natural measure of ductility; and in many cases, a close relation has been proved to exist between these properties. In one instance, four different mixtures of brass were studied. Their tensile strength was raised to 73,000 pounds per square inch by different degrees of cold treatment, and the reduction in area of these samples was found to be 32, 40, 56, and 62 per cent, respectively. These values are in direct proportion to the percentage of copper and the actual ductility of the mixtures. In other cases, however, no similar relation exists, and the reduction of area may be just as misleading an indication of ductility as the elongation. The brittle brass referred to in connection with Fig. 1 and the cold-rolled copper in Fig. 3 have the same local reduction of area, *i. e.*, 25 per cent, despite the great difference in their properties. In addition to the occasional difference, the use of the reduction figures does not prove practical for commercial tests, as it is often hard to obtain reliable measurements of the broken section; moreover, the reduction depends upon the shape of the section, the cross-strain being less uniform in a flat bar than in a round one.

For these reasons the reduction figures are not fit to use as a general index of the ductility of the metal. Therefore it seems advisable to resort to the diagram of local lengthening. This is certainly less handy than one figure, but it furnishes a true and reliable proof for our purpose, *i. e.*, the more marked its elevation near the point of fracture, the more ductile is the metal. On the other hand, the straighter and more uniform the line, the more brittle is the material. The average elongation, measured by the mean ordinate of the diagram, is only of secondary importance to the general character of the curve. The ductility may also be judged approximately from the outline of the broken test-bar. It must be remembered, however, that this outline is of a less distinct character than the elongation diagram, for the former is proportional to the square root while the latter is proportional to the full value of the area.

* * *

During the past few years, at large exhibitions of machinery, motor cars and other manufactured products the rule has been to enforce uniformity of decoration, signs and other features of the booths of exhibitors. It was made in the interest of harmony and has worked well. No longer do we see booths gaudily decorated in glaring color schemes and exhibiting signs of great size or hideous designs. Everything is uniform and harmonious, and no one exhibitor can secure an advantage over another except in position and space that he pays for.

The rule of uniformity might be extended to include all literature distributed at such shows. The same argument that applies so forcibly to the arrangement and decoration of booths can be applied with equal force to the advertising literature. Advertising literature, uniform in size and style, distributed at a show would be more effective as a whole than the varied and motley mass of stuff now given away. One who visits a motor car show and collects the catalogues, circulars, leaflets, booklets, etc., distributed for the purpose of examining them at leisure has an unwieldy mass on his hands that cannot be conveniently arranged or filed. If every piece of advertising literature distributed was, say, 6 by 9 inches or 9 by 12 inches, the collecting and filing of all the advertising literature would be made much easier and more effective than it now is. Managers of advertising shows might specify the size, shape, color and quality of paper to be used for describing the products shown. To insure uniformity, they might go still further and insist that each exhibitor furnish cuts and copy for the literature it wishes to be distributed at the show, and have all printed in uniform style under the direction of the show management.

* * *

The electrolytic process of cleaning metals is comparatively new, but has recently been introduced by many large manufacturing concerns. The process is cheap and good results are obtained. Baths composed of alkaline substances such as sodium carbonate or potassium carbonate with small portions of potassium cyanide are used. With a current of from four to eight volts, these develop sufficient hydrogen to remove organic substances from the metals, leaving them chemically clean.

ROLLED THREADS FOR SCREW SHELLS

The American Society of Mechanical Engineers appointed May 1, 1914, a committee to take up the subject of standardization of special threads. During June, 1912, some of the manufacturers of electric wiring supplies and lamps held a meeting in the attempt to standardize these threads, and arrived at a practical compromise on those then in use. Later, however, it was thought advisable to modify certain features of the standard agreed upon in 1912, and another meeting of manufacturers was held March 18, 1914. At this meeting the American Society of Mechanical Engineers was asked to take up the subject, and make recommendations. This resulted in the appointment of the committee mentioned. The committee has held two meetings for the consideration of this subject, and has conducted numerous conferences with manufacturers and corresponded in detail with a number of the largest manufacturers. Only minor changes on the generally recognized standard have been made. Twenty-seven manufacturers have approved the recommendation.

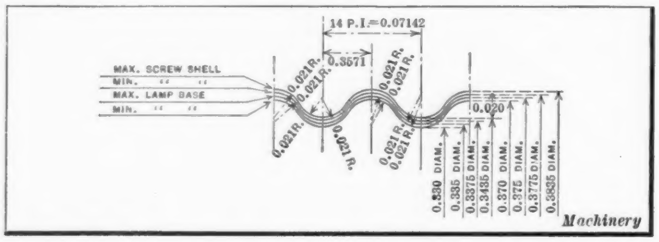

Fig. 1. Miniature Size Lamp-base and Socket Thread

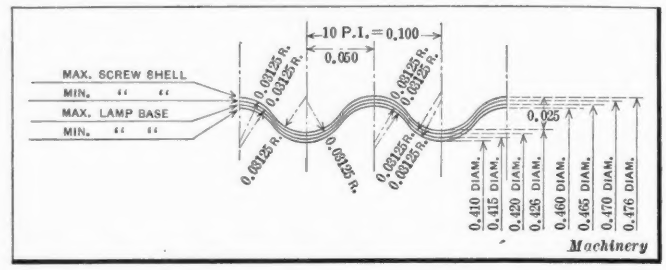

Fig. 2. Candelabra Size Lamp-base and Socket Thread

TABLE I. LAMP BASE AND SOCKET SHELL THREADS—MINIATURE SIZE

	Socket Screw Shell	Lamp Base Screw Shell
"Go" gage, top of thread	0.3775 in.	0.3750 in.
"Not Go" gage, top of thread	0.3835 in.	0.3700 in.
"Go" gage, bottom of thread	0.3375 in.	0.3350 in.
"Not Go" gage, bottom of thread	0.3435 in.	0.3300 in.
Threads per inch	14	14
Depth of thread	0.020 in.	0.020 in.

Machinery

Fig. 1 shows form of thread and repeats the above dimensions.

TABLE II. LAMP BASE AND SOCKET SHELL THREADS—CANDELABRA SIZE

	Socket Screw Shell	Lamp Base Screw Shell
"Go" gage, top of thread	0.470 in.	0.465 in.
"Not Go" gage, top of thread	0.476 in.	0.460 in.
"Go" gage, bottom of thread	0.420 in.	0.415 in.
"Not Go" gage, bottom of thread	0.426 in.	0.410 in.
Threads per inch	10	10
Depth of thread	0.025 in.	0.025 in.

Machinery

Fig. 2 shows form of thread and repeats the above dimensions.

TABLE III. LAMP BASE AND SOCKET SHELL THREADS—MEDIUM SIZE

	Socket Screw Shell	Lamp Base Screw Shell
"Go" gage, top of thread	1.045 in.	1.037 in.
"Not Go" gage, top of thread	1.053 in.	1.031 in.
"Go" gage, bottom of thread	0.979 in.	0.971 in.
"Not Go" gage, bottom of thread	0.987 in.	0.965 in.
Threads per inch	7	7
Depth of thread	0.033 in.	0.033 in.

Machinery

Fig. 3 shows form of thread and repeats the above dimensions.

TABLE IV. LAMP BASE AND SOCKET SHELL THREADS—MOGUL SIZE

	Socket Screw Shell	Lamp Base Screw Shell
"Go" gage, top of thread	1.565 in.	1.555 in.
"Not Go" gage, top of thread	1.577 in.	1.545 in.
"Go" gage, bottom of thread	1.465 in.	1.455 in.
"Not Go" gage, bottom of thread	1.477 in.	1.445 in.
Threads per inch	4	4
Depth of thread	0.050 in.	0.050 in.

Machinery

Fig. 4 shows form of thread and repeats the above dimensions.

The standards recommended are given in the accompanying illustrations and tables. There are four sizes for both male and female shells. The male shells are used on lamp bases, fuse plugs, attachment plugs, etc., and the female shells for electric sockets, receptacles and similar devices. The male shells are usually known as lamp-base screw shells, and the female as socket screw shells.

It is recommended that for each size of lamp-base screw shells there should be two threaded ring gages to govern the diameter of the bottom of the threads, and the form of the thread; also two plain ring gages to govern the diameter of the top of the thread on the outside. For each size of socket screw shells, there should be two threaded plug gages to govern the diameter of the top of the thread inside, and the form of the thread; also there should be two plain plug gages to govern the diameter of the bottom of the thread inside. These gages should be marked "go" and "not go," respectively.

The committee recommends that these thread standards be known as the "American" standard.

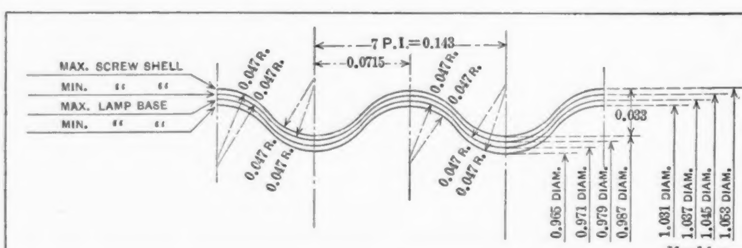

Fig. 3. Medium Size Lamp-base and Socket Thread

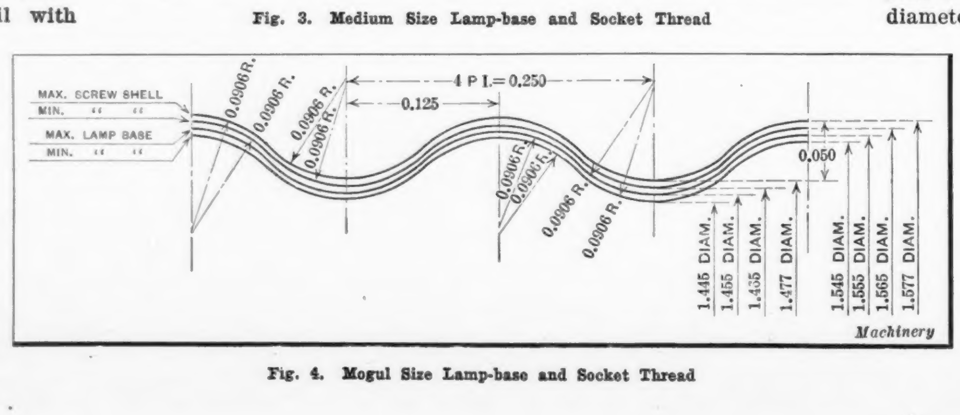

Fig. 4. Mogul Size Lamp-base and Socket Thread

LETTERS ON PRACTICAL SUBJECTS

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A PINCH PRESS TOOL

The work done by a "pinch" tool is really drawing and cutting, and it is accomplished in one stroke of the press. The scope of this type of tool is, of course, limited, but for work of the kind illustrated in Fig. 1 it has distinct advantages. The samples of work shown are parts of jewelry.

An assembly view of the die used is shown at *A*, Fig. 2. This consists of a die-plate and stripper attached by screws and dowels, much the same as in an ordinary blanking die.

In drilling the plate for the dowels, it is advisable to drill the holes only part way through the plate from the back, as shown. This is to prevent the dowels from dropping out when the tool is in action. The punch is made to fit the die snugly, but not too tight, as illustrated at *C* in Fig. 4. The outside of the plate is made identical in shape with the inside of the cup that is to be made. The travel of the punch into the die is illustrated graphically at *C*. The drawing plate *a* should, of course, be hardened and polished to a mirror finish. This is to insure that the cup will drop off the punch instead of

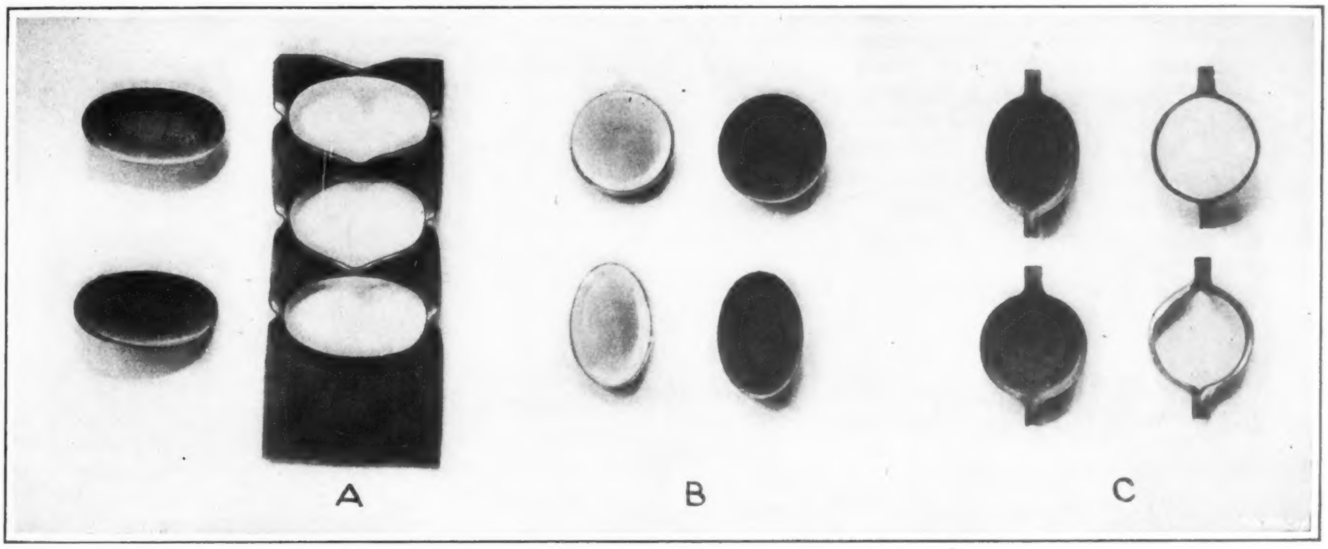


Fig. 1. Samples of Work showing Strips from which Cups are made

The die-plate is shown in detail at *B*, Fig. 2. The hole in the die is made in the customary way by filing or broaching. This hole is relieved in the back to avoid excessive friction and heating. The dimension *x* is made a little greater than the depth of the cup to be drawn. The mouth of the hole, instead of being left with a sharp corner as in the case of an ordinary blanking die, is curved to a short radius *r*. This round edge allows the blank to form into a shallow cup instead of shearing when the punch strikes it. The radius of curvature of the edge is dependent largely upon the depth of cup. For a shallow cup a short radius will do, while for a deeper cup the radius must be longer.

The punch used with this class of die is shown at *A*, Fig. 4. This is the same as an ordinary blanking punch except for the drawing plate *a*, which is screwed and doweled in front of the cutting edge. The front edge of the plate has a short radius. The thickness of this plate is approximately equal to the inside depth of the cup. This plate is shown located by two dowels and attached with one flat-head screw in the center. After drilling and tapping the hole for this screw in the punch proper, it is good practice to countersink the mouth. This provision is made so that when the punch is sharpened by grinding the face, and the plate is returned to its place, the head of the screw will not bottom on the punch proper.

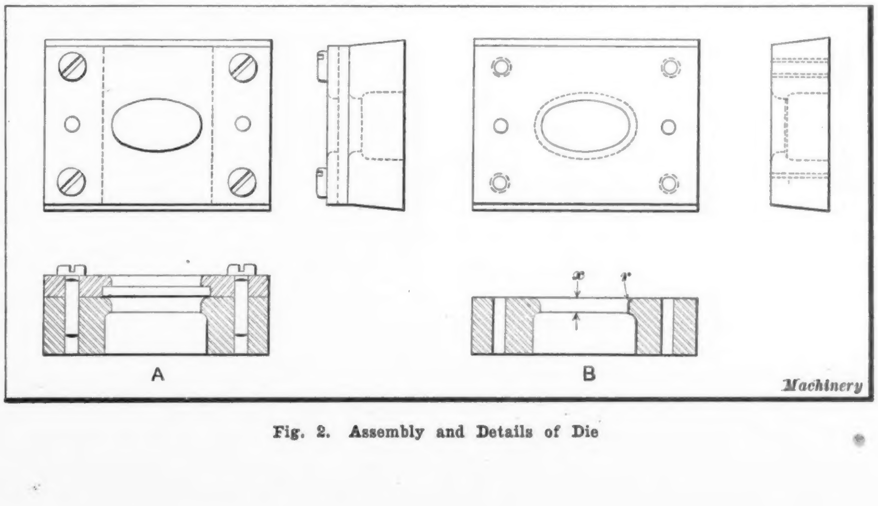


Fig. 2. Assembly and Details of Die

being carried back into the strip. In the case of odd shapes, however, there is sometimes trouble. This can be overcome by the provision of a knock-out, similar to that illustrated at *B*. The principle of this device is apparent.

In some cases, where the punch is being made for a very narrow cup, it is impossible to attach a separate drawing plate with screws and dowels. It is then customary to form this shape from the punch.

The maximum depth of cup that it is possible to obtain in this type of tool is dependent somewhat upon the material used, whether silver, gold, brass or gold plate. The depth is also affected by the radius at the mouth of the die, as previously explained, as well as the thickness of the drawing plate. The greatest depth of the samples shown is approximately 1/8 inch. The cups shown at *A*, Fig. 1, have a difference in depth of about 0.020 inch. These were both made in the same die, the difference being obtained by using a thicker drawing plate.

The action of the tool in operation is as follows: As the punch descends upon the stock the drawing plate immediately begins to cup the metal. The cupping is continued until the cutting edge of the punch has traveled a little below the surface of the die. At this point the cup is pinched from the strip, rather than sheared from it as is the case in an ordinary

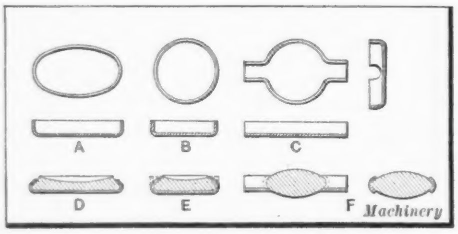


Fig. 3. Samples of Work shown in Section

blanking die. The strips of metal are well oiled before being fed to the tool. It is customary to use this tool in a common blanking press, using a roll feed. The action as compared with a double-action press tool is exactly the reverse. In the double-action press tool the blanking takes place first and is followed directly by the drawing. In this tool, the drawing or cupping takes place first, and the blanking or pinching last.

Various shapes of cups that have been successfully made with this punch and die are illustrated in Figs. 1 and 3. At *A*, *B*, and *C*, Fig. 3, are illustrated in detail the shapes of these various cups. The same cups are illustrated at *D*, *E*, and *F*, Fig. 3, with jewels or stones in them. The cup *C*, Figs. 1 and 3, is of special interest because of its complicated shape. This is cupped in the ordinary way, after which the bottom is pierced out, leaving virtually a ring of metal with two lugs attached. The stone is then dropped in and the top part of the ring rolled over, holding it securely.

The pinch type of press tool is quite satisfactory in certain classes of jewelry work, and it is probable that there may be other lines of work for which it would be equally adaptable.

T. E. W.

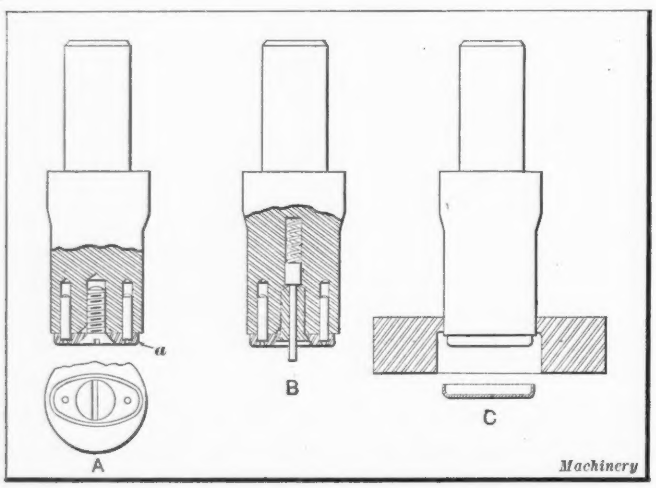


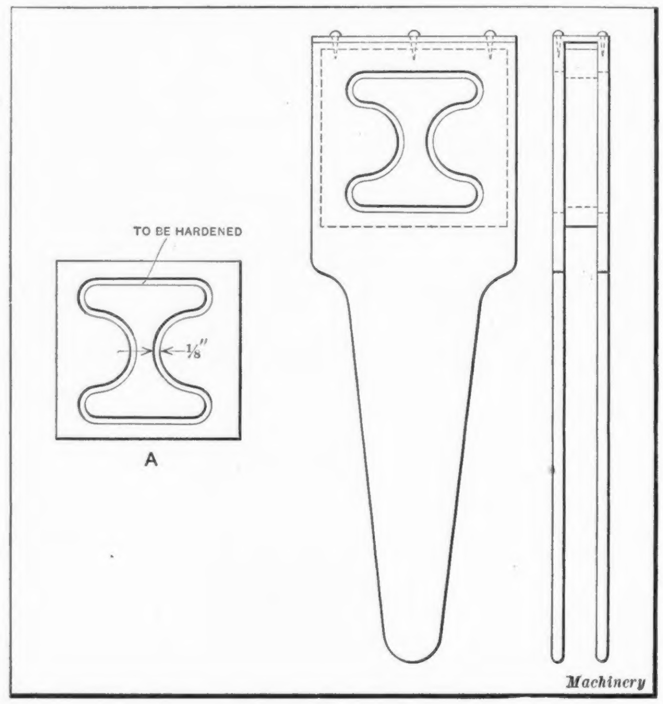
Fig. 4. Punch used with Die shown in Fig. 2

METHOD OF LOCAL HARDENING

We had a set of dies to harden, in which it was required to quench the metal around the cutting edges and leave it soft enough at other points to retain the maximum toughness. After trying various methods with little success, I hit upon a scheme which gave very satisfactory results. The illustration shows the die *A* to be hardened, in which it was required to have the metal quenched around the edges of the opening for a depth of about 1/8 inch, while the rest of the steel in the die was to be left as soft as possible.

After the dies were finished and ready to be hardened, I took two pieces of soft wood a little wider and larger than the dies. These pieces of wood were carved out to provide a handle at the end, after which a recess was cut in each piece to hold the die in position. The next step was to cut an opening in each piece of wood to correspond to the hole in the dies, but these openings were made 1/8 inch larger all around than the size of the hole in the dies; this opening represents the outline which is to mark the boundary of the hardened steel in the dies. The two pieces of wood were then fastened together at the end with a piece of leather.

The dies were placed in the furnaces and brought to the required quenching temperature. One of the dies was then drawn from the furnace and placed in the socket in one of the wooden handles, after which the other handle was dropped on top of it so that the die was held between the two pieces of wood. This was done as quickly as possible in order to avoid burning the wood, and with the die-block in place the handles and die were plunged into the quenching bath. The result was that the water flowed through the hole in the die and quenched the steel around the hole; but the wooden handles protected the remainder of the die from the action of the quenching bath, and as a result, this part of the metal remained fairly soft.



Die to be hardened around Opening, and Die in Place in Local Hardening Device

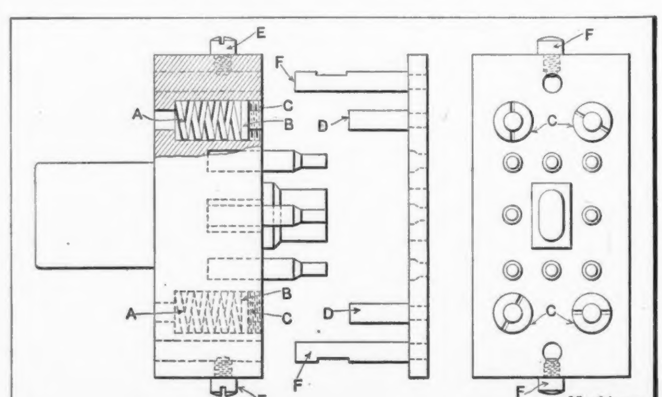
This method of hardening will be found useful in the heat-treatment of numerous parts in which local hardening is desirable.

Hyde Park, Mass. PAUL CYR

DETACHABLE SPRING STRIPPER

The accompanying illustration shows a detachable spring stripper applied to a perforating punch. The advantage of this stripper is that it may be removed from the punch in setting up the tools on the press, which will give greater space for doing this work; and after the tools have been set up, the stripper is put in place ready for use. Anyone who has had experience in setting up spring stripper punches and dies will readily appreciate the advantage obtained by this construction.

In the accompanying illustration, the punch-holder has four holes—one of which is shown in the cross-sectional view—in which are located springs *A* of sufficient strength to strip the work from the punches. In each of the holes a flat plate



Detachable Spring Stripper which is put in Place after Dies are set up on Press

B is held down on the spring by means of a hollow set-screw *C*, and in operation a pin *D* on the stripper-plate presses against each of the plates *C*. Screws *E* enter notches in pins *F* to retain the stripper-plate in place. The pins *D* on the stripper-plate should be just long enough so that the stripper will project 1/64 inch beyond the end of the punches. Any number of springs can be used to give the required power for stripping the work from the punches, but it will always be found advisable to use at least three springs, regardless of the amount of power that is required.

Rochester, N. Y. CARL M. WEBER

ALUMINUM ALLOY FOR PATTERNS AND CORE BOXES

I have made some experiments to find a suitable aluminum alloy of reasonable cost for use in making patterns and core boxes. We wanted an alloy that would be both strong and light. Thinking that the result of my experiment would be of benefit to other master mechanics, foundry foremen, pattern-makers, etc., the following alloy, which at normal metal prices costs about twenty cents a pound, has a tensile strength of 30,000 pounds per square inch: Aluminum, 65 parts; zinc, 25 parts; ferro zinc, 10 parts. This metal finishes beautifully and is easily mixed in the crucible.

Augusta, Ga. EUGENE BART,
M. M., Augusta Arsenal.

[Ferro zinc is a commercial product sold by the American Alloys Co., Baltimore, Md.—EDITOR.]

PEROXIDE IN BLUEPRINT MAKING

If ten drops of peroxide are added to one gallon of water, a solution will be made that will aid in producing even blueprints. Wash the blueprint as usual in clear running water, then place it in the peroxide solution, after which wash again in water. If a blueprint has been correctly exposed or under-exposed, the solution will have no effect. If, however, the print has been over-exposed, the solution will restore it to the true color.

Another important feature of this solution is that it will restore old blueprints if they have become faded. As an experiment, take a print that has been exposed ten or fifteen times the proper amount, place in this solution and it will be restored permanently to a fair blue color.

Cleveland, Ohio. H. L. JUDD

WASHED GASOLINE FOR CLEANING TRACINGS

Undesirable effects are often produced when a large number of tracings are cleaned with gasoline. Among the effects noticeable are streaks and the outlines of spots after the tracings have been gone over with gasoline in the attempt to remove grease and dirt. The reason for this is found in impure gasoline. Seldom, if ever, can gasoline be obtained that is free from dirt and a certain amount of crude grease.

To overcome this and to produce gasoline absolutely clean for use in cleaning tracings, it should first be washed. This can be done by mixing warm water with all the soap that can be absorbed; then when soapy enough, pour the gasoline into the bath. Place the cover on the receptacle and shake or stir thoroughly. After standing, the cleaned gasoline can be drawn off, as it separates from the dirty water. In this form, it can be used for cleaning tracings without the effects noticeable with impure gasoline.

Somerville, Mass. FRANK H. JONES

DELAY IN OPENING FOREIGN MAIL

Perhaps it has never occurred to the average person that if a large quantity of first-class mail matter, destined abroad and addressed to one person, was distributed among several small envelopes, instead of being put in one large one, not only would delays in delivery abroad be reduced, but the attendant inconvenience and annoyance of having the mail opened at the post office by the custom officers would be almost eliminated.

By way of example: most machinery manufacturers, when a request is made by a foreign prospect for prices, catalogues, blueprints, contracts, etc., invariably insert all this matter into one large envelope. This makes a large and bulky package which looks as though it contains dutiable matter, and warrants the postal authorities in holding it up for the action of the customs people. Then the customs officials make examination of the contents of the package to determine whether or not duty is to be assessed on same. Before the matter is finally disposed of by the customs officers, there is always a delay of several days.

This delay and opening of the mail before it reaches its destination could be entirely avoided if the matter were placed in several envelopes, as, usually, no inspection is made for customs purposes of the contents of small envelopes. It might be suggested that the weight of each envelope be not greater than three or four ounces. While the use of several small envelopes, instead of one large one, will slightly increase the cost of postage, the advantage of obtaining quicker delivery and the avoidance of opening by the custom officials more than outweigh this small additional expense.

New York City. WILLIAM H. MEYER

BRUSHING CHIPS OUT OF COLD SAWS

In the January number of MACHINERY, we note what Mr. Atkins has to say in reference to removing chips from cold saws. We have used this plan for removing chips from cold saws, and the machine exhibited by us at the last convention of the American Railway Master Mechanics and Master Car Builders Associations at Atlantic City, N. J., was so equipped.

We write of this because no mention was made of our machine, and because the subject is brought up as a new idea; on the contrary it is not new, inasmuch as we have used wire brushes for this work for some time. W. S. HOWE,

Hinsdale, N. H. Treasurer and General Manager,
Nutter & Barnes Co.

JIG AND FIXTURE DESIGN

Jig and fixture design has often been discussed in MACHINERY, but I would like to add a few words on binding screws and clamping devices. There is practically no limit to the various applications of these which can be recommended, and an attempt to narrow down the subject by confining the discussion to square and knurled-head screws still leaves a very broad field. By making such a classification, consideration must be given to the questions of first cost and suitable size of the jig or fixture, and to the tolerance or clearance that can be allowed on the work; and this practically prohibits the establishment of any standard designs. A good tool designer should disregard all precedents when developing jigs and fixtures for handling a given class of work, but the number of men who actually work along such lines is extremely small. Such designers will use a square-headed screw for one jig and a totally different form of screw for another; they show no preference for one clamping or locating device over another, the choice in each case being based on the requirements of the work in hand.

Part of my experience in tool designing was obtained with an automobile concern whose superintendent boasted that he had $40,000 worth of jigs and fixtures in use and that in all of these tools there was not a single screw used for clamping purposes. Various forms of eccentrics and latches were employed, and limiting the tool designers to these two methods was undoubtedly the cause of a considerable waste of time and money. After leaving this concern I worked under a man who condemned the first design I submitted for his approval on which eccentric clamps were used; after looking over the drawings he gave positive orders never to employ the eccentric principle of clamping. These two cases show the powerful influence which prejudice plays in the work of tool design,

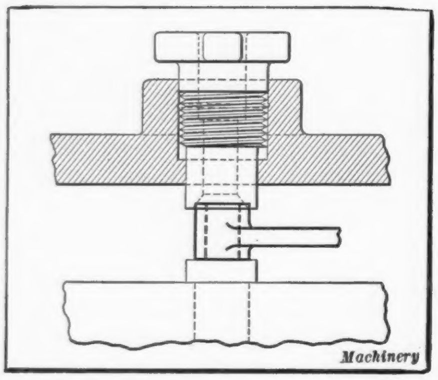


Fig. 1. Screw Bushings give Trouble from Chips clogging the Threads

and it is fair to assume that the objection which certain individuals have for various methods is due to unsatisfactory results obtained with a given method as the result of poor designing or workmanship. About the best advice that can be given to the tool designer who wishes to give satisfaction is to tell him to follow the old adage, "When in Rome do as the Romans do."

Having mentioned the prejudices of two employers for whom I have worked, I will now outline certain opinions which I have formed as the result of a somewhat extensive experience in tool designing. I only tolerate the use of screw bushings when no other means of clamping can be successfully employed—assuming that there is such a case. The chief objection to the use of screw bushings is that they all wear loose after being in service for a short time. Reference to Fig. 1 will make it evident that the end of an unfinished boss is not a very desirable locating point, and Mr. Staples' reference to trouble experienced from chips finding their way into threads is certainly based upon fact. Furthermore, experience will show that it is extremely difficult, if not impossible, to protect the threads of this bushing in such a way that trouble from chips will be entirely overcome.

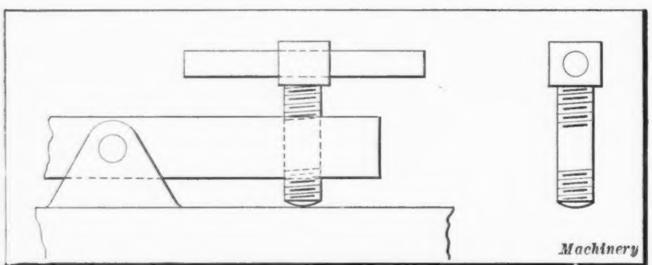
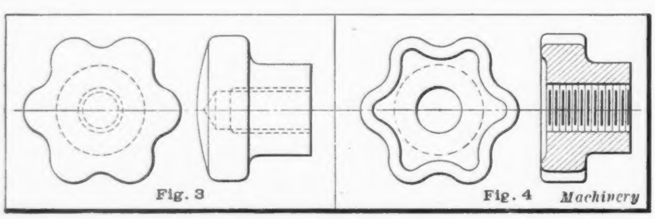


Fig. 2. Binding Screw with Pin through Head



Figs. 3 and 4. Type of Star Knob that excludes Chips and Poor Design on which Collection of Chips accumulates over Threaded Hole

Star knobs for clamping screws should be made as shown in Fig. 3, so that the threaded hole does not come through; but they are often made as shown in Fig. 4 with a cup-shaped top which collects a nice supply of chips all ready to find their way into the thread, where they are sure to give trouble. In many factories a number of knobs are carried in stock which were designed years ago, and the designer uses them as a matter of economy, but these knobs are often too small to enable a good grip to be secured on the work and so short that the operator rubs his knuckles over the top of the fixture in trying to screw down the knob. For ordinary purposes, such knobs should never be less than 1¾ or more than 2½ inches in diameter. Cast-iron knobs of the form shown in Fig. 3 are cheaper to make than knurled knobs and do not have the same tendency to make the operator's hands sore. There are certain instances, however, in which a knurled knob possesses advantages over the cast knob, a case in point being where there is danger of applying too high a clamping pressure. It is fair to assume that the operator will exert the same effort in screwing down knobs of either type, and the knurled knob does not afford quite such a good grip. Where the work is very thin, the best plan is to have the knob quite small so that it must be turned with the thumb and finger, as shown in Fig. 5.

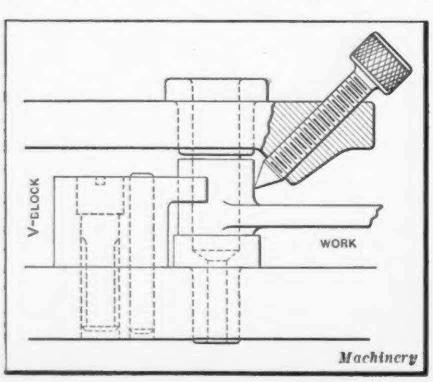


Fig. 5. Small Knurled Knob which is turned by Thumb and Finger

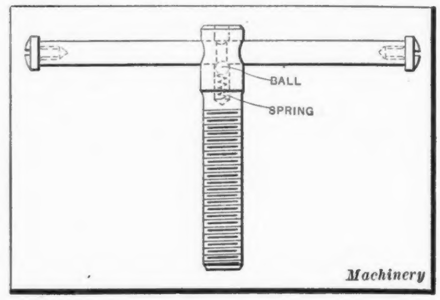


Fig. 6. Binding Screw provided with Vise Handle

There are several objections to the use of a binding screw with a pin through its head, such as the one advocated by Mr. Staples, which is illustrated in Fig. 2. The construction looks cheap, and in my opinion a jig or fixture should be made to look like the precision instrument which it really is. If only a hand pressure is employed, the use of a pin-headed screw of the form shown in Fig. 2 is likely to make a workman's hands sore; and the use of such pins constitutes a standing invitation for the operator to tighten the screw by hitting the pin with a hammer. If the head of the screw is made square, as shown in Fig. 7, there is insufficient room for the use of a wrench in making the final tightening, so that the expense of squaring up the head of the screw is unwarranted. As a substitute for the two preceding types of screws, the writer would suggest the application of a screw provided with a vise handle, as shown in Fig. 6. In this case the ball and spring allow the handle to be located in the center for rapidly turning down the screw, after which the rod is pulled out to one extreme position to provide sufficient leverage for tightening the screw.

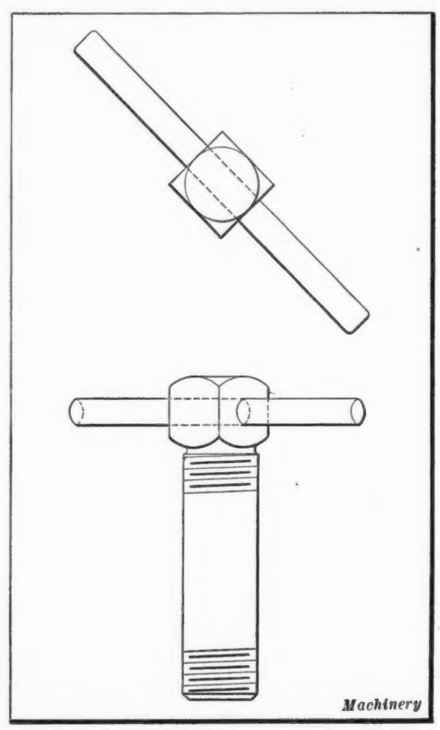
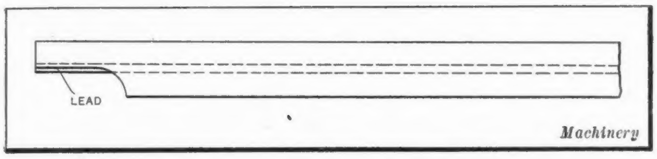


Fig. 7. Square-head Screw with Pin through Head

Dayton, Ohio. GEORGE M. MEYNCKE

TOOL-ROOM KINK

When making blanking dies, difficulty is often experienced in putting a thin even coat of Prussian blue onto the templets to which the dies must be fitted. But unless the Prussian blue is so applied it is practically impossible to get a good impression. I have found that by using an indelible



Indelible Pencil used in fitting Blanking Dies to Templets

blue pencil with the wood cut off from one side as illustrated, very satisfactory results can be obtained if the lead is slightly moistened before rubbing the pencil around the edge of the templet. By this method a better impression is made on the die than can be obtained by the Prussian blue.

Long Island City, New York. E. KERN

HAND-OPERATED WIRE BENDING FIXTURES

The progressive bending of the wires *A*, *B*, *C*, and *D* in Fig. 1 might seem to warrant the use of an expensive wire forming machine especially equipped for the purpose. The fact that the finished part, as shown at *D*, is completed in two simple bench fixtures shows the advisability of looking into

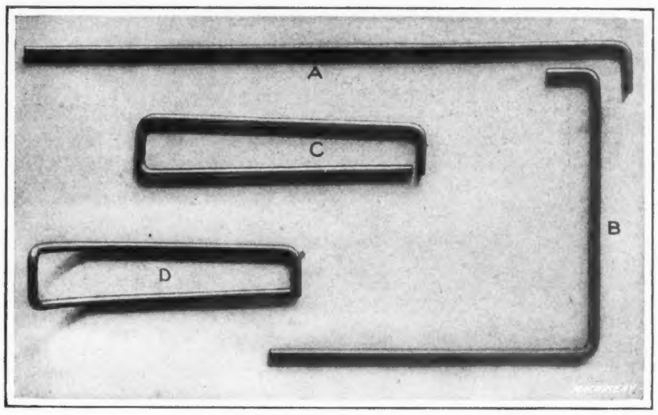


Fig. 1. Wire bent to Shape in Four Operations

the limitations of simple fixtures before tying up an expensive machine with a job of this nature.

Four operations are required to finish the piece after the wire is cut off. The first three are accomplished in the fixture shown in Fig. 2. As illustrated diagrammatically at *A*, Fig. 3, the straight wire is placed in the fixture, being located by the extension gage *a*, and the handle *b* is rotated in such a way that the wiper *c* forms the wire at right angles. The wire is then placed in the fixture in the manner illustrated at *B*. The handle *b* is again operated, and another right-angle bend is accomplished at the other end of the wire. After this, the wire is placed in the fixture as illustrated at *C*. The result is a finished article with the exception of one other operation, as clearly shown at *C*, Fig. 1.

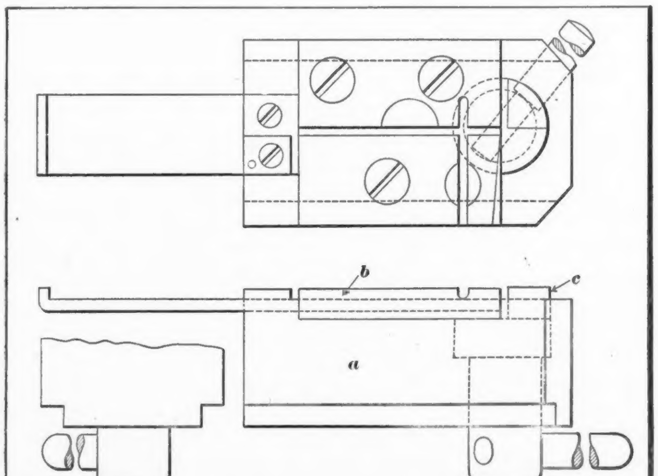


Fig. 2. Fixture for First Three Operations

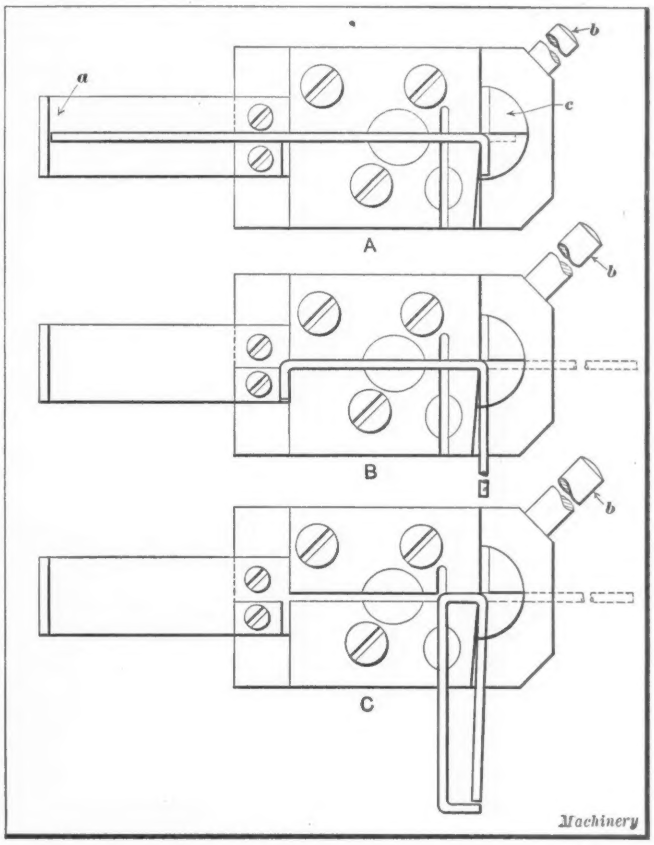


Fig. 3. Diagrammatical View of First Three Operations in One Fixture

The construction of the fixture shown in Fig. 2 is very simple. The base *a* is of cast iron. The inserted block *b* is made

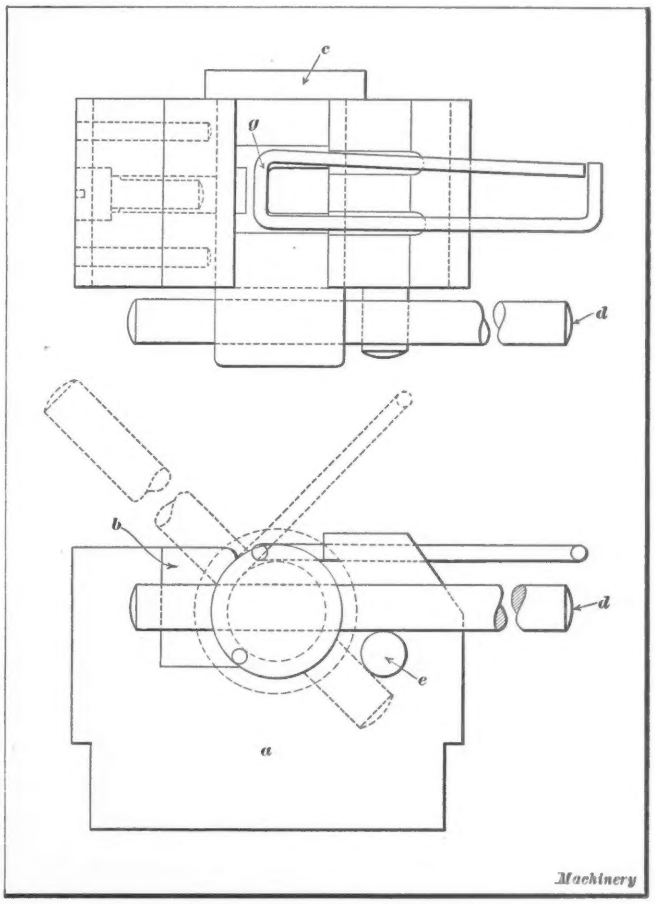


Fig. 4. Fixture for Fourth Operation

of tool steel and hardened, as is also the wiper *c*. Two L-slots are cut in the base to assist in holding the fixture in an ordinary vise.

The final operation of putting the curve on the wire, as shown at *D* in Fig. 1, is accomplished in a simple fixture

shown in Fig. 4. This fixture consists of a mild steel base *a*, a hardened tool steel anvil *b*, a hardened tool steel wiper *c*, a handle *d*, and a stop-pin *e*. The wiper *c* has two channels cut on its outer circumference for the reception of the wire. These two channels are connected by a longitudinal slot. The wall of this slot *g* acts as a hook for the wire.

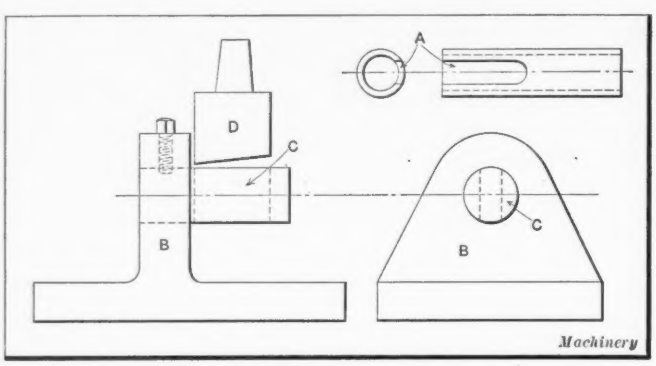
In operation, the wire is placed on the top of the fixture in such a way that the closed end lies in the slot *g*. When the handle *d* is operated in a counter-clockwise direction, the wire is carried with the wiper against the anvil *b*, causing it to conform to the contour of the wiper *c*. The travel of the handle *d* is limited in its forward direction by the stop-pin *e*, at which point the wire has received sufficient bending. Then the handle is reversed and brought back to its original position, when the correctly formed wire may be removed from the fixture.

In any wire bending fixture, it is necessary to bend the wire further than the curve requires, in order to overcome the "spring back" which exists in all wire to a greater or less degree. To obtain the amount of overthrow necessary is largely a matter of experiment. In the case of music wire for springs it is, of course, excessive.

Arlington, R. I. GEORGE P. BREITSCHMID

TUBE SLOTTING DIE

In a shop engaged in the manufacture of textile machinery there are a large number of tubes to be slotted at one end, as shown at *A* in the accompanying illustration; the tubes are 5/16 inch in thickness, and the slot is 5/8 inch wide by 2 inches long. To reduce the amount of time taken to cut these slots on the milling machine, I made a punch and die which has proved to be a great time-saver. The die-holder *B* is bored to hold die *C* which is the same diameter as the inside of the tubes to be slotted. The opening in the die is of the required size of the slot, and punch *D* is made so it will just enter the opening in the die. It will be evident that, in operation, the tube is slipped over die *C* and when the press is tripped punch *D* descends and shears the slot in the end of the work. Over 900 tubes have now been slotted with this tool and it is still in excellent working order.



Die used for slotting Ends of Steel Tubes

Hyde Park, Mass. PAUL CYR

PRACTICE IN SCRAPING MACHINE PARTS

Referring to the "How and Why" question and answer regarding practice in surface scraping machine parts in the January number, my practice has been to apply a thin coat of Prussian blue mixed with lard oil to the surface plate, distributing it evenly so that the high spots on the work are marked by the color rubbed off the surface plate. Some toolmakers wear colored glasses to reduce the glare of the light reflected from the bright surfaces. The darker the color of the scraping compound, the better, in my opinion.

Moline, Ill. E. O. GRASSLEY

Responding to your request on page 428 for information on scraping, I herewith submit the consensus of opinion of several men who have scraped surfaces exclusively for some years. On cast iron and steel it is preferable to use the compound directly on the surface to be scraped, while on white metal and brass the reverse is true, the compound being placed on the surface plate. The best compounds to use are: for cast iron and steel, venetian red mixed with oil; for white metal and brass, lampblack mixed with oil. The use of these combinations will make the high spots easily discernible. From the information on hand, nothing definite can be said regarding which method will produce the greater wear on the surface plate, but it is the general experience that when the plate is used extensively it will require frequent truing up and should be checked with a master plate kept for that purpose.

Madison, Wis. WILLIAM J. SANSOM

DIAL PRESS KINK

I would like to add another dial press kink to the list of useful suggestions along this line which have appeared in MACHINERY from time to time. The present idea is somewhat similar to the one described in the November, 1914, number, which explained a method of removing a flat bottomed shell from a dial plate in case the shell was put in upside down, the method consisting of pushing a second shell into the dial in the correct position with its bottom covered with oil.

It often happens, however, that shells are formed with a round bottom and when one of these shells is put in the dial plate upside down, it cannot be removed by the method referred to. In such cases I have found that a piece of wood about 1/2 inch in diameter by 4 inches long, one end of which has been dipped into the pail containing belt dressing, will stick tight enough to enable the shell to be drawn out of the dial regardless of its shape. The use of this kink has been the means of saving a great amount of time in our dial press department. DIAL PRESS

* * *

THE ADVANCING PRICE OF GASOLINE

The large number of motor cars in use and the great export trade in petroleum and petroleum products that has developed since the outbreak of the war have produced a shortage of gasoline. The price has gone up from eleven or twelve cents to twenty-five cents a gallon in the past year, and the prospect is that it may reach thirty-five or forty cents a gallon before the end of 1916. Earnest efforts are being made to find a substitute for gasoline. Denatured alcohol which a few years ago gave so much promise of becoming a cheap substitute is no longer considered seriously because the demand for the vegetable products from which it is made is so great that to convert them into alcohol is prohibitive. In 1915 the gasoline consumed by automobiles was 13,000,000 barrels, and lubricating oil, 20,000,000 gallons. The cheapest sources of gas, of course, are coal, coke, lignite and peat. Inventors are working on the problem of designing a portable gas producer which will be light, efficient and capable of making producer gas for motor cars and motor trucks. The problem is not new, and some progress has been made in the direction of developing a light and portable gas producer plant. Diesel type motor car engines would also tend to relieve the situation, as a whole barrel of oil could be utilized as fuel instead of a few gallons only, which is the condition now. One reason for the high cost of gasoline not mentioned in the foregoing is the closing of the Panama Canal by the great slides. The closing of the canal has stopped the cheap transportation of oil from the California oil fields, and all that comes east now must either be transported by the transcontinental railroads or take the long course through the Straits of Magellan.

* * *

The following aluminum alloy, which was patented by W. H. McAdams, April 7, 1914, is claimed to possess great fluidity in the molten condition and to make strong castings that do not tarnish: aluminum, 70 parts by weight; zinc, 26 parts; copper, 3 parts; silver, 1 part. The castings have a silver-like surface and are sufficiently strong to be used in the great majority of cases where brass is now used. The alloy resists acids and alkalis to such an extent as to make it desirable for general use. The small quantity of silver required adds but little to the cost.

NEW MACHINERY AND TOOLS

THE COMPLETE MONTHLY RECORD OF NEW DESIGNS AND IMPROVEMENTS IN AMERICAN METAL-WORKING MACHINERY AND TOOLS

THE "WARREN" AUTOMATIC HYDRAULIC LATHE

The features that distinguish this lathe from the general run of lathes is that it is hydraulically operated, and the feed is secured by advancing the spindle, rather than advancing the turret. Because of the fact that the spindle is hydraulically operated the thrust resistance which consumes so much power in all common machine tool design is largely eliminated, and the power efficiency of the machine is high.

In the design of the "Warren" automatic hydraulic lathe, which has been developed by the Lombard Governor Co. of Ashland, Mass., the experience of the company in building hydraulic governors has been utilized and applied to the operation of machine tools. A general view of the machine is shown in Fig. 1, while Fig. 2 shows a side elevation of the machine from the rear, the indexing mechanism, and the spindle in section. The indexing and spindle control mechanism as shown in Fig. 1 varies from that shown in Fig. 2, but the latter shows the present design to best advantage. From these two views, in conjunction with Fig. 3 which shows end elevations of the machine, an idea of the principles involved and the operation of the machine may be obtained. This machine is for the automatic production of turned work from the bar, or for work that must be handled by chucking. The particular machine illustrated in this article has been made without a cross-slide because the work on which it will be used can be handled without a cross-slide, but it is the intention of the Lombard Governor Co. to furnish these machines with cross-slides for general work. The machine in the illustrations has been tooled up for the manufacture of 18-pound British high-explosive shells, and the operations are illustrated in the following.

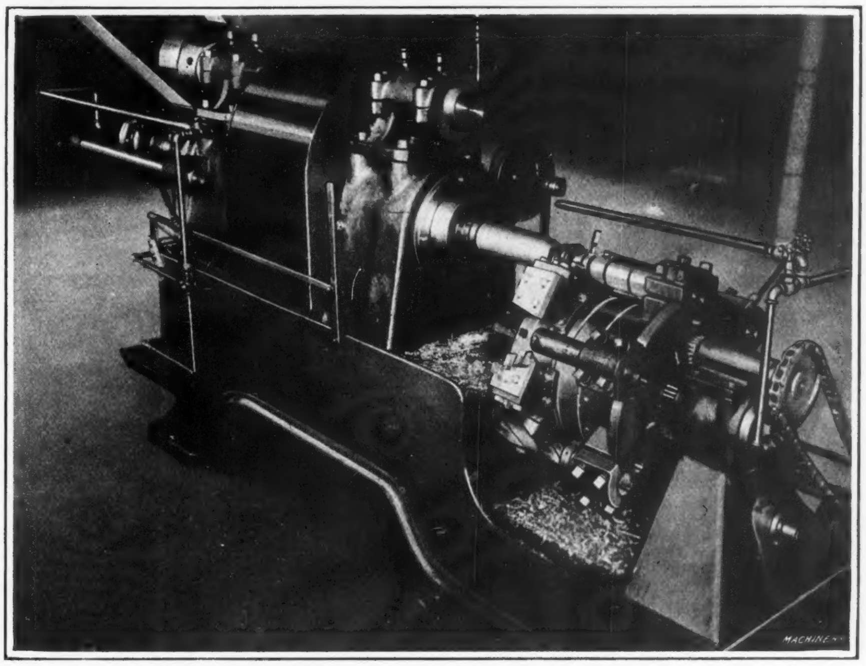


Fig. 1. "Warren" Automatic Hydraulic Lathe

Features of the Machine

Briefly, the design of the machine includes a large spindle 9 inches in diameter mounted in a massive frame. This spindle is hydraulically advanced to and withdrawn from the tools that are held in the turret at the opposite end of the machine. The turret has no longitudinal movement, and its only function is to carry the tools and index for different operations. The moving parts of the machine are very simple and few in number, and there are no slides, gibs or adjustable parts to wear or introduce lost motion. The frame itself is very

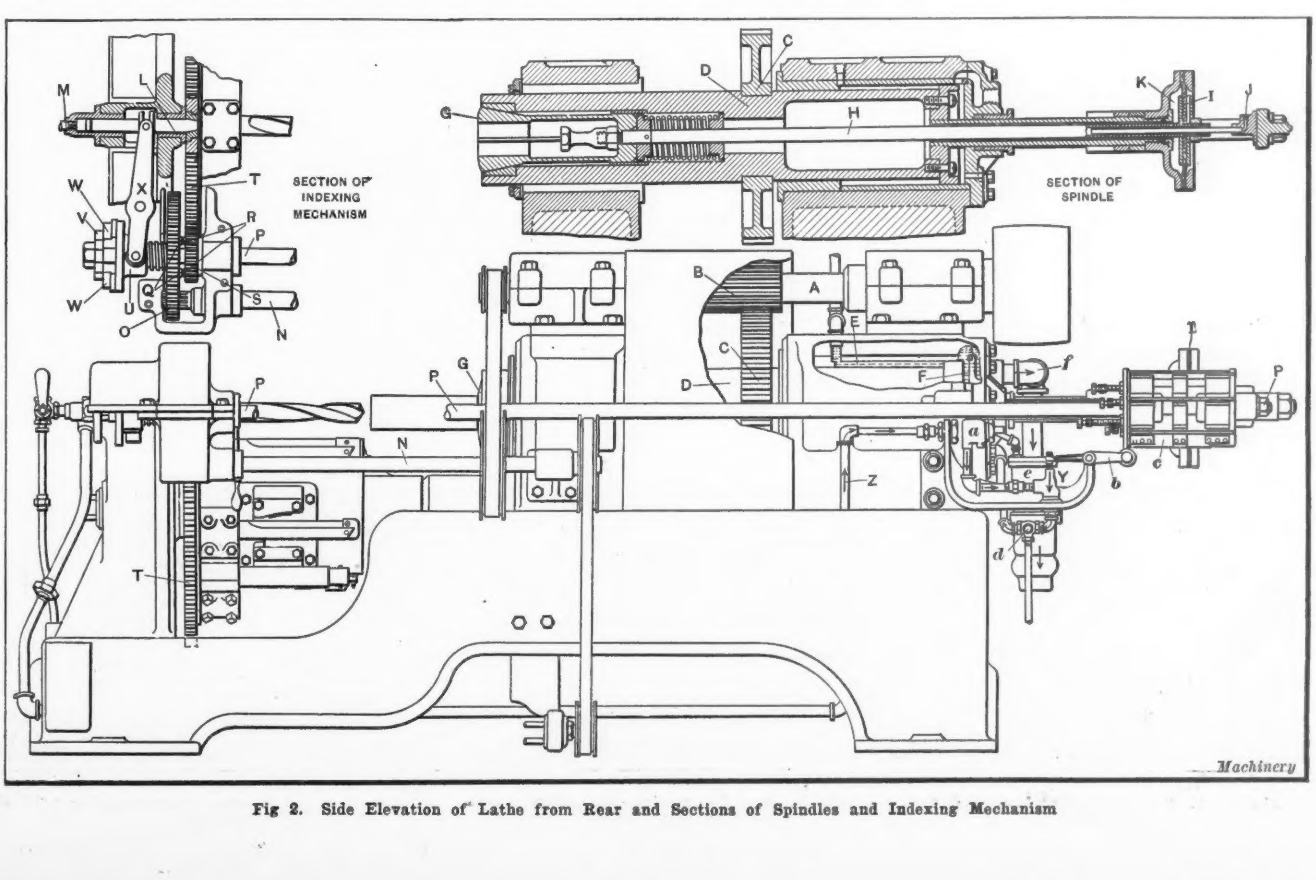


Fig 2. Side Elevation of Lathe from Rear and Sections of Spindles and Indexing Mechanism

heavy, and is cast with the spindle and turret bearings integral. Referring now to Fig. 2, the details of the construction may be observed. The drive is through a spindle pulley from the overhead countershaft to the main drive shaft *A* of the machine. This drive shaft is 3 inches in diameter, has bronze bearings 12 inches long, and 36 inches is the distance between the centers of the bearings. This drive shaft is operated by a 15-horse-power motor through the overhead countershaft and an 8-inch double-thickness belt. Integral with this drive shaft is a pinion *B*, 15 inches long, that drives the spindle through a driving gear *C* on the spindle. The ratios between this pinion and gear are 5¼ to 1. The object of the long pinion *B* is to provide means for driving under the varying positions of the spindle as it advances or withdraws.

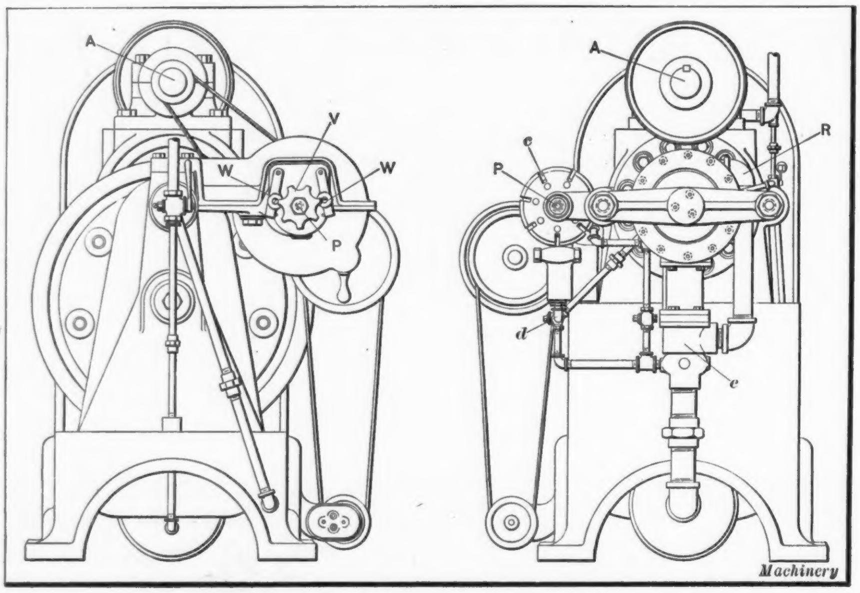


Fig. 3. End Elevations of "Warren" Automatic Hydraulic Lathe

The Spindle Mechanism

The spindle, which is shown at *D* in the sectional view at the upper part of Fig. 2, is made of cast iron and ground to size. It is made hollow to receive the chuck operating mechanism, the chuck and work. The spindle runs in cast-iron bearings at the front that are 12 inches long. The rear bearing is in two sections; one of these is 5⅞ inches long, and the other is formed by the contact of the piston as it slides on the cylinder wall. The action of the spindle is practically frictionless, as it is surrounded by a light film of oil. Moreover, there is no thrust friction whatever, as the pressure is taken entirely by the oil in the cylinder.

The spindle is kept normally withdrawn by means of the pressure of the oil in the cylinder *E*. This oil is piped direct from the accumulator, and is at a pressure of 150 pounds. The advancing of the spindle is by means of oil pressure at the rear end of the spindle piston in chamber *F*. It is obvious that before the spindle can be advanced the pressure of 150 pounds must be overcome, and the method of admitting oil to the chamber at the rear of the piston for the advancement of the spindle will be taken up in detail later.

The hollow spindle is recessed at the front end to accommodate the collet chuck *G*. This has the customary tapered end, that fits in an inserted steel seat in the spindle end. The chuck is provided with a positive stop for the location of the work, and a chuck operating rod *H* extends back through the entire length of the spindle to the chuck-closing diaphragm *I*. The stock is gripped in the chuck by hydraulic pressure through opening *J* that admits oil into the diaphragm chamber *K*, thus forcing back the diaphragm. As the chuck rod connects the diaphragm with the chuck, any backward motion of the diaphragm carries the chuck back into its tapered seat and causes it to grip the stock.

Turret Mechanism

Referring now to the left-hand end of Fig. 2, the turret may be observed. The shaft upon which the turret rotates is 3½ inches diameter and is supported at each end in bearings 5 inches long. This shaft does not rotate, but acts as a tie-rod between the outer bearing and the frame of the machine, and supports the turret proper. The turret bearings are bronze-bushed. The turret tool line is 20 inches diameter, and for the job for which the machine is set up, seven tool holes are provided. The turret has no motion save indexing, and it is held in the working positions by a locking pin *L* that seats in steel bushings inserted behind the tooling position at the various stations. From the plan view of the turret operating mechanism, shown at the upper left-hand corner of Fig. 2, the method of indexing may be seen. The locking bolt *L* is kept normally seated by oil pressure entering behind the pin at *M*. This oil pressure is at 150 pounds and before the pin can be withdrawn it is obvious that this pressure must be overcome. On the outer left-hand end of the drive shaft *A* is a small pulley that carries rotation to the indexing shaft *N* at the rear side of the machine. This may be seen in the foreground of Fig. 2. On the shaft at the extreme left-hand end is an integral pinion that carries rotation to a sleeve gear *O* rotating loosely on intermediate shaft *P*. In addition to being free to rotate on the shaft, sleeve gear *O* may be moved slightly longitudinally so that studs *Q* may be engaged with studs *R* that are on gear *S*. The function of gear *S* is to operate indexing gear *T* and hence the turret, after locking pin *L* has been withdrawn by the mechanism which will now be described.

Shaft *P* extends the full length of the machine and reciprocates with the main spindle of the machine through its connection with the bracket that holds cam-strips *c*. Keyed to the extreme left end of this shaft is a star plate *V* that may best be seen in Fig. 3. On the frame between plate *V* and gear *O* is a sliding collar *U*. On the outer face of this collar are two swinging arms that carry rolls *W*. When shaft *P* comes back with the return of the spindle, star plate *V* strikes the two rolls *W* on the fingers and pushes collar *U* to the right. This motion carries lever *X* and hence pulls out the locking pin *L*, leaving the turret free to rotate under the action started by gear *O*. Gear *O*, being moved to the right, locks with the indexing gear, and thus rotation is carried to gear *T* on the turret, and the turret is rotated until indexing pin *L*, under pressure of the oil entering through pipe *M*, springs into the next turret hole.

It will be seen from the end view of the mechanism in Fig. 3, that as soon as shaft *P* has turned 1/14 of a revolution, the

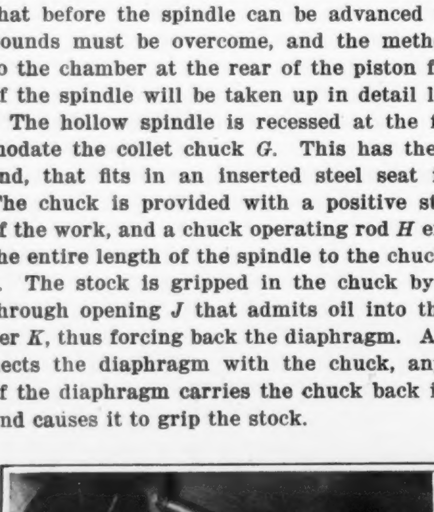


Fig. 4. First Operation—roughing Nose and centering

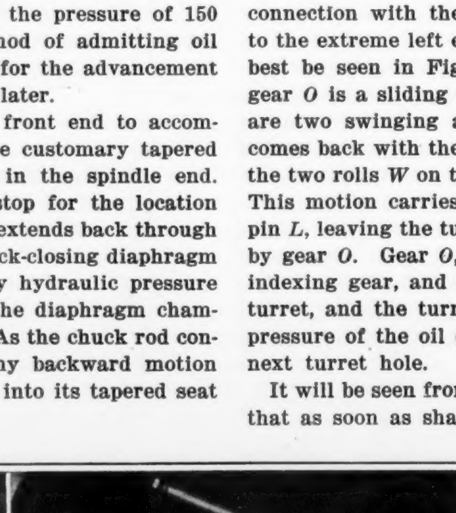


Fig. 5. Second Operation—drilling and rough-turning Outside

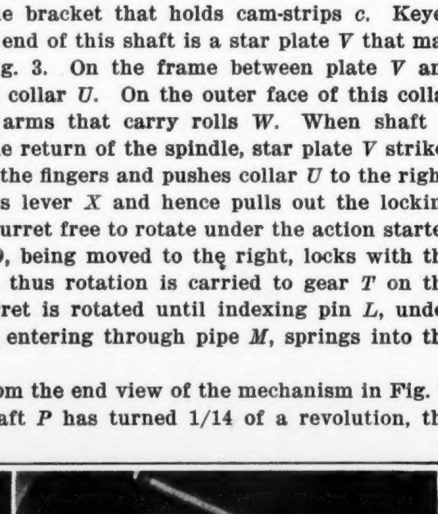


Fig. 6. Third Operation—finish-turning and reaming

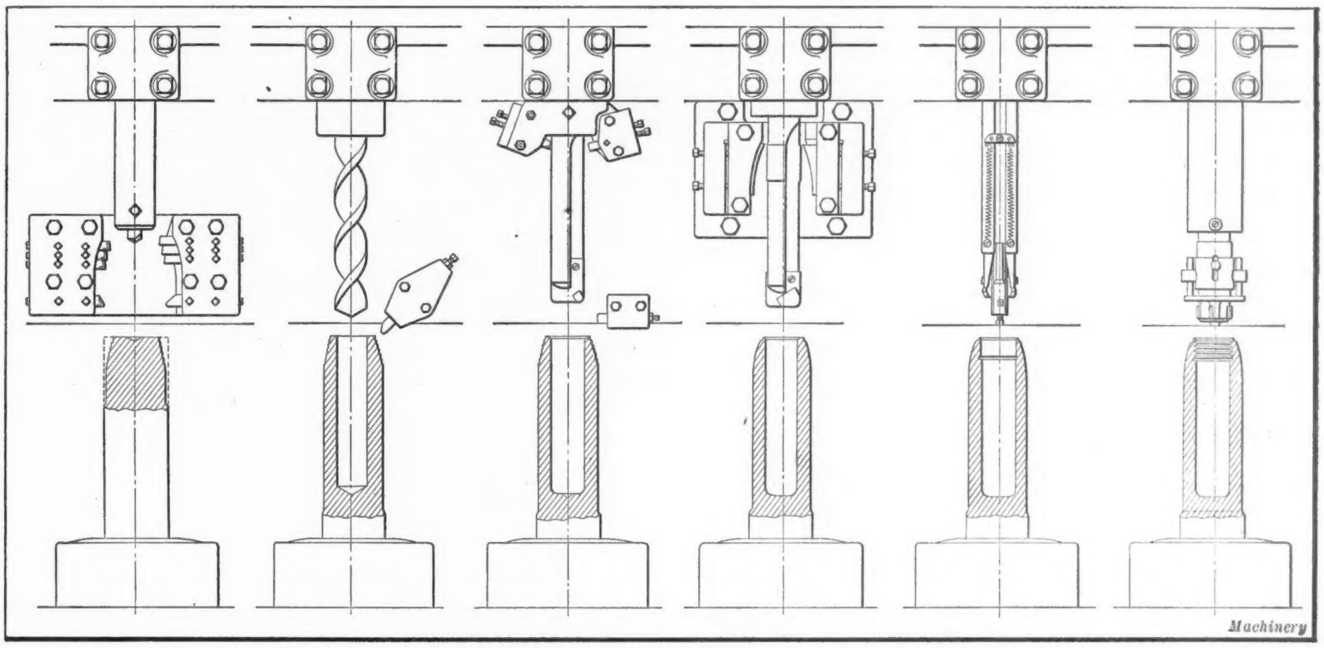


Fig. 7. Tooling Layout for Six Operations in making a High-explosive Shell

two rolls W will be in line with spaces in the edge of the star plate V. This allows bracket U to slip quickly to the left, and the locking pin is thrown in and retained by the oil pressure behind it. The relation between gears S and T is such that six-sevenths of a revolution of gear S is sufficient to rotate gear T one-seventh of a revolution—the amount necessary for indexing from station to station.

Mechanism for Controlling Travel of Spindle

With the hydraulically operated mechanism to be described, the spindle of this machine may be advanced at any rate of feed from the smallest amount possible to as high as one-quarter of an inch per revolution, or even faster if desired. It has been stated before that the constant pressure of the oil supply in chamber E exerts a pressure of 150 pounds to the square inch, which amounts to approximately 1000 pounds total pressure. This constant pressure on the spindle in a backward direction insures that there will be no advancing of the spindle through leakage or other unintentional means, as this pressure must be first overcome before any forward spindle motion can take place. To obtain the different rates of travel for the advance of the spindle, the oil is admitted to chamber F either slowly or rapidly as desired, by means of a spindle control needle valve shown at Y, the oil supply pipe being shown at Z. The course of the oil may be followed through the primary stop valve a, thence down around and through the spindle control needle valve Y which governs the rate of flow of the oil. This needle valve may be opened to any desired orifice by lever b that terminates in a roll that is acted upon by cam strips c. There are seven of these strips, one for each turret operation to be performed. These cam strips are located in a cage, and may be inclined to give a constantly increasing or diminishing rate of flow of oil through the needle valve, or they may be irregularly shaped so as to open or close the needle valve quickly any desired amount. From the needle valve the oil stream flows down past an emergency valve d that may be operated by hand if necessary, thus quickly diverting the oil pressure from the cylinder. Past this valve the oil flows and thence into chamber F to advance the spindle.

By means of this needle valve controlling mechanism, the supply of oil may be cut off at any predetermined point, and the automatic return valve e is operated simultaneously, thus allowing the oil to drain the cylinder quickly through the large automatic return valve. A pressure gage is provided that indicates the cylinder pressure at all times. By thus opening the automatic return valve suddenly, the spindle moves back rapidly. It does not strike against the rear head however, because as soon as the enlarged end of the piston has crossed the entrance point for the oil, the small amount which remains acts as a cushion and prevents further backward motion of the spindle. At the base of the machine and driven from shaft N is a pump that supplies lubricant to the turret tools through the center of the turret shaft. As each turret station is reached, the oil supply is carried to the cutting point through an individual outlet that is cut off as soon as the station passes the operating point.

Operation of "Warren" Hydraulic Lathe on High-explosive Shells

A good illustration of the capabilities of this machine is the turning of a high-explosive shell. Figs. 4 to 6, and 8 to 10 show the work and tooling for each station, and Fig. 7 gives a general summary of the way the work is handled. The rough stock is 3½ inches diameter and is cut off in lengths 19 9/16 inches long—enough to produce two shells. This double length blank is gripped in the chuck, allowing stock enough for one shell to extend from the chuck.

At the first turret position, a series of step tools rough the nose of the shell down to shape, and a center drill is run in the end. At the second turret station, the hole is drilled the entire depth of 8 inches, in exactly four minutes, and a roughing cut taken over the length of the shell. At the third sta-

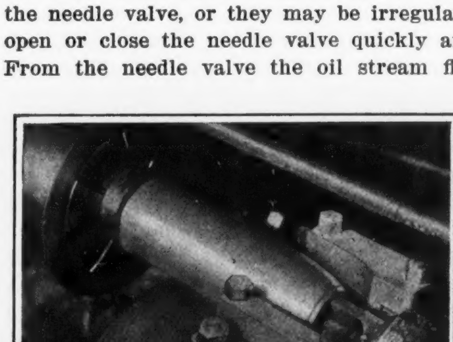


Fig. 8. Fourth Operation—forming Bottom of Hole and shaping Nose

Fig. 9. Fifth Operation—recessing for End of Thread

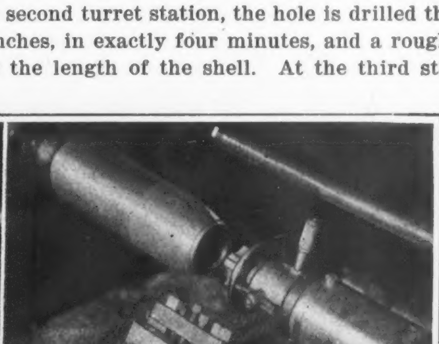


Fig. 10. Sixth Operation—tapping out Nose of Shell

tion, the shell is finish-turned on the outside, the end of the shell is sized, and the hole reamed. At the fourth station, the bottom of the hole is finished and the nose is finished with wide forming tools. At the fifth station, the recess for the end of the internal thread is cut, and at the sixth station the hole is threaded for the fuse plug. The seventh station is not required on this job. The total time for all these operations is less than fifteen minutes. The bar is now reversed and the same operations performed on the other end, after which it may be cut apart and the base end of each shell finished.

A modification of these machines is being built by the company to rough-turn the entire outside of 9.2-inch shell forgings, including cutting off at the large end, turning the nose, and boring a hole for the fuse, in a time interval of less than twenty minutes. This hydraulic lathe has been so designed as to require for its operation a minimum amount of skill and muscular effort. One operator can easily attend to several machines. Manning, Maxwell & Moore, Inc., 119 W. 40th St., New York City, are the United States agents for these lathes.

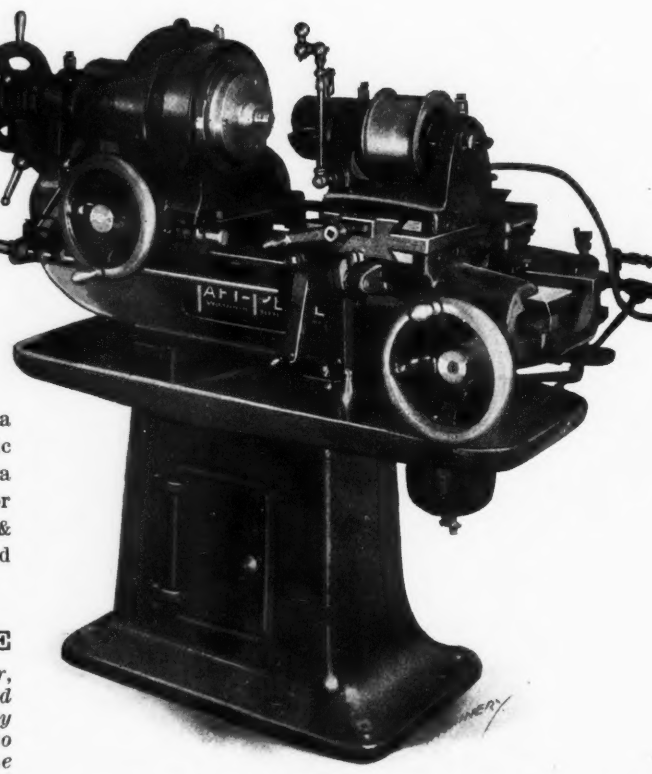


Fig. 2. End View showing Arrangement of Slides on Cutter-head

TAFT-PEIRCE THREAD MILLING MACHINE

This machine is of the type which uses a multiple cutter, the length of which is the same as the width of the threaded portion of the work. To complete milling a thread, it is merely necessary to advance the spindle through a distance equal to the pitch of the thread, and to have the spindle make one complete revolution. This principle enables a high rate of production to be attained. The regular capacity of the machine is for work up to 4½ inches in diameter by 18 inches in length; but work up to 17½ inches in diameter by 8 inches in length can be handled provided it is of a character that can be driven from a center hole or in some similar way. The machine is adapted for the performance of both internal and external threading operations, and one operator can look after two to four machines according to the character of the work.

The Taft-Peirce Mfg. Co., Woonsocket, R. I., has recently acquired the manufacturing and selling rights in the United States for a thread milling machine which was originally developed by J. Archdale & Co., Ltd., Birmingham, England. This machine is of the type that employs a milling cutter which is virtually a straight threaded hob, *i. e.*, there is no lead to the thread; the cutter is of the same width as the length of the threaded part of the work, and one complete revolution of the work-spindle plus a slight over-travel completes the threading operation. The machine is particularly adapted for a high rate of production in milling the threads on various parts of relatively short length, and is capable of a high degree of accuracy. The general features of the design will be readily understood by reference to Figs. 1 and 2. An idea of the range of work for which this machine is adapted will be obtained by referring to Fig. 3, and it will be of interest to note that one operator can attend to from two to four machines, according to the nature of the work.

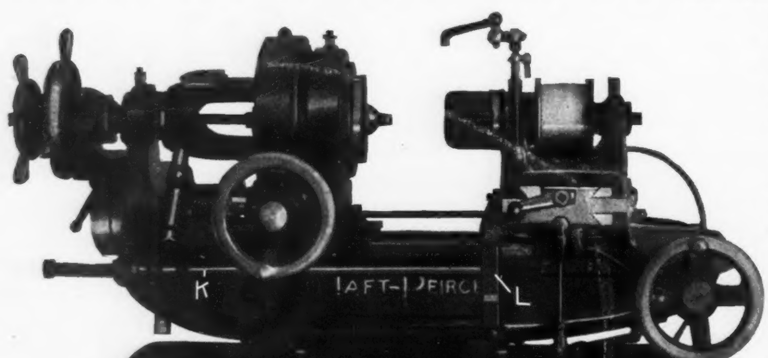


Fig. 1. Archdale Thread Milling Machine built by the Taft-Peirce Mfg. Co.

In order to explain the operation of the machine, the more important parts of the mechanism will be described in detail. Figs. 4 and 6 show the work-head, and it will be evident from these illustrations that all parts have been liberally proportioned. The work-spindle is a large cylindrical member which is bored out at *A* to receive special faceplates on which various forms of work-holding fixtures are mounted. The work is held in place by a draw-back mechanism which is operated by a handwheel *B* at the extreme left-hand end of the spindle. The spindle bearings are provided with tapered bronze bushings and effective means of lubrication. The front bearing is 6⅞ inches in diameter by 4 inches long, and the rear bearing 2⅛ inches in diameter by 2½ inches long; the distance between the centers of the bearings is approximately 15 inches.

The pitch of the thread to be milled on the work is governed by a lead-screw *C* and nut *D* located at the left-hand end of the spindle. The lead-screw is a shell that fits over the end of the spindle, and it will be seen that it is made in two sections, the positions of which may be adjusted to compensate for wear. The end of the spindle is turned down to receive the lead-screw, and it will be evident that screws of the required pitch must be furnished for each class of work that is handled on the machine.

It has already been mentioned that one complete revolution of the work-head is required in order to finish a thread milling operation on this machine. Power is taken from an overhead countershaft which drives a five-step cone pulley on a jack-shaft at the rear of the machine, five changes of work-spindle speed being provided in this way. From the jack-shaft, bevel gears transmit the motion to the worm-shaft *E*, which is located beneath and at right angles to the work-spindle. The worm on this shaft drives the spindle through a straight-toothed worm-wheel.

The reason for employing a worm-wheel with straight teeth is that the work-spindle must be advanced through a distance equal to the pitch of one thread in order to secure the required

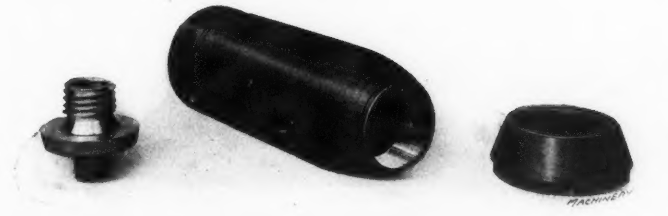


Fig. 3. Examples of Pieces threaded on Taft-Peirce Machine

pitch for the thread milled on the work. As previously explained, this advance of the work-spindle is secured by means of lead-screw *C* and nut *D*. Worm-shaft *E* is made hollow in order to receive clutch shaft *F* which extends through it and operates a clutch on the driving shaft of the machine. A handwheel *G* is provided on worm-shaft *E*, and at the center of this handle there is a push-knob *H* for operating the clutch, both of which are shown in Fig. 4.

Fig. 5 shows the relative positions of the cutter-spindle and work-spindle when in operation; and Fig. 7 shows a partial cross-sectional view through the cutter-head. The cutter-spindle is carried by tapered bronze bushings and is belt-driven from an overhead countershaft which provides three changes of cutter-spindle speed. It will be seen from Fig. 7 that the entire cutter-head is mounted on a compound slide. The position of the cutter-head may be adjusted by the upper slide to

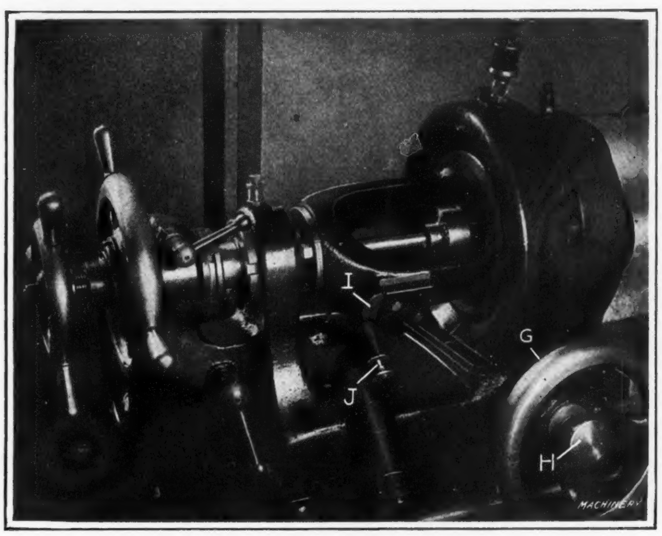


Fig. 4. Close View of Work-head and Cam for releasing Cutter-head

secure the required setting for the work to be threaded, and after this setting has once been made, it needs no further adjustment while the machine is engaged on the same class of work. The lower slide provides means of withdrawing the cutter from the finished work and returning it to the cutting position after a fresh blank has been mounted on the work-spindle.

The withdrawal of the cutter from the work after the thread milling operation has been completed is accomplished by a cam mounted on the work-head. At the time that the revolution of the work is completed, this cam—which is shown at *I* in Fig. 4—engages a trip-pin *J*. In Fig. 4 the cam is shown in contact with the trip-pin, and the manner in which the withdrawal of the cutter from the work is effected may be briefly described as follows: The engagement of the cam with the trip-pin results in transmitting motion through a link mechanism consisting of two bellcranks to the horizontal shaft *K* which will be seen at the front of the machine in Fig. 1. The result is that this shaft is moved to the right and disengages the locking lever shown at *L* in Fig. 7. When the cutter is in the working position the upper end of locking lever *L* is located in a slot extending across the lower slide and its frame, the transverse position of the slide being held constant in this way. When the cam on the work-head operates the trip mechanism, locking lever *L* is withdrawn, which allows a spring to throw the cutter-slide back so that the cutter is withdrawn from the work. After cam *I* has passed over pin *J*, shaft *K* is returned to its original position by a spring at its right-hand end.

Before any thread milling operation can be started, it is first necessary to draw the work-spindle back to the starting point, *i. e.*, through a distance equal to the pitch of the thread

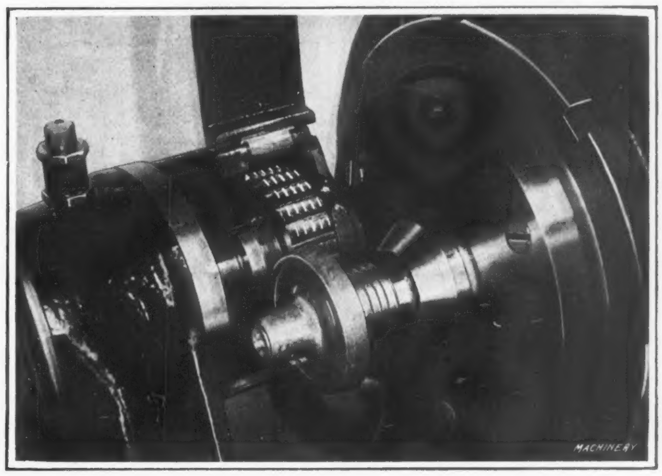


Fig. 5. Close View of Cutter engaged in milling a Thread

on the work. This is done by turning handwheel *M* on the work-head spindle, shown in Fig. 6; but before this handwheel can be operated, it is necessary to withdraw locking pin *N* that holds the handwheel while the machine is in operation. The withdrawal of the locking pin is effected by lever *O* which carries a pinion that meshes with rack teeth cut in the locking pin. As soon as handwheel *M* has been turned sufficiently to withdraw the work-spindle to the starting point, locking pin *N* comes into alignment with another hole in the handwheel, and spring *P* then pushes the pin into this hole.

When this part of the work has been completed, a fresh blank is set up on the work-spindle, after which it is necessary to return the cutter-slide and cutter to the working position, which is done by pulling up lever *Q* at the front of the cutter-head. This results in advancing the cutter into the work a distance equal to the depth of the thread, and when this position of the cutter-head has been reached the locking lever *L* drops into position in the slots in the slide and frame of the machine—which have been brought back into alignment—and the cutter-head is locked in this way until the thread milling operation is completed.

The preceding description of the method of procedure in

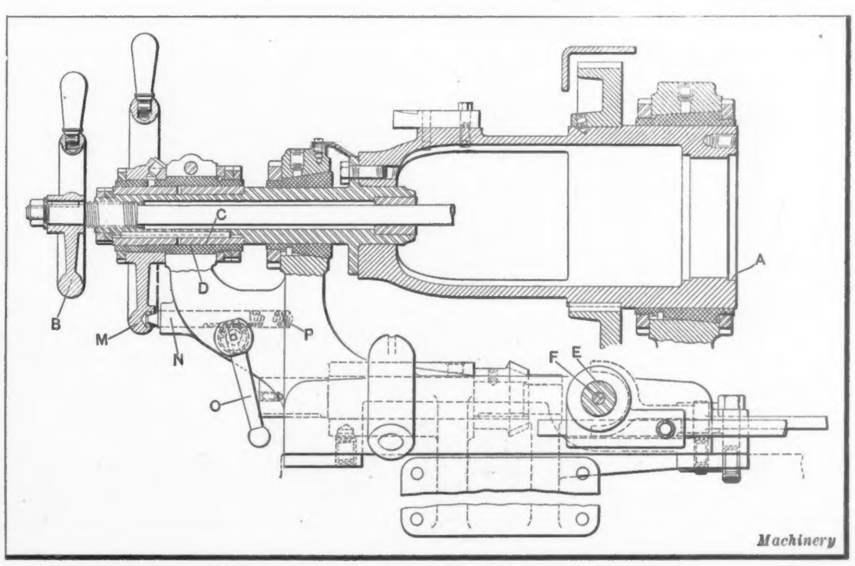


Fig. 6. Partial Cross-sectional View of Work-head

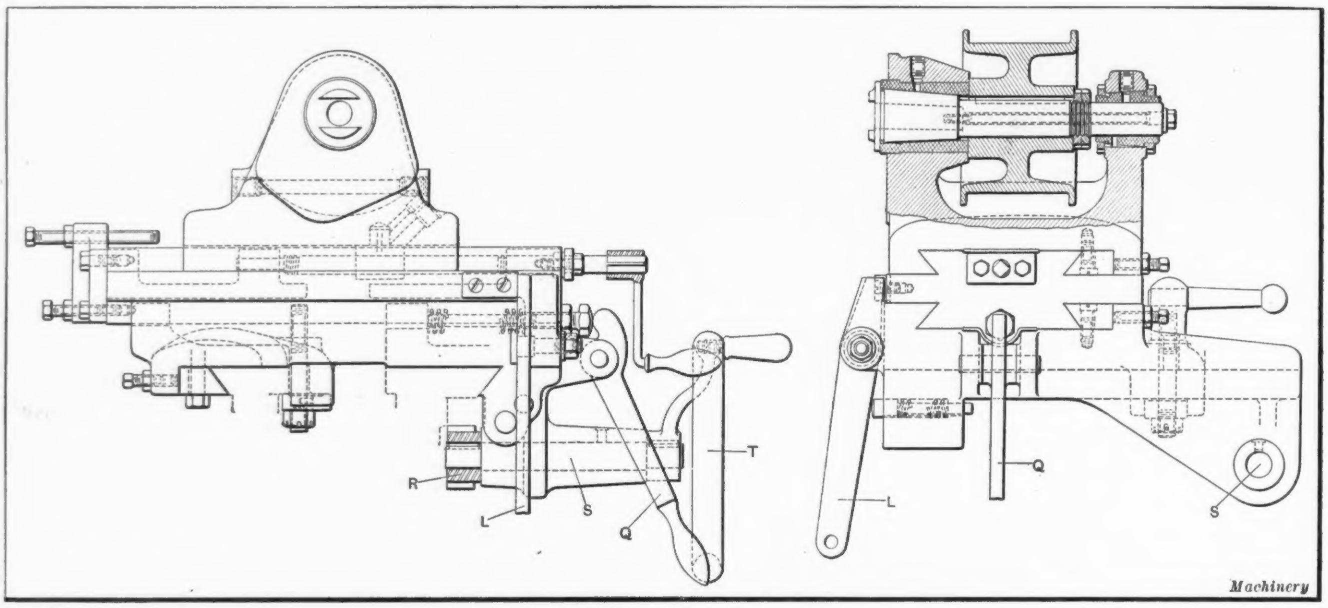


Fig. 7. Partial Cross-sectional View and End View of Cutter-head

preparing the machine for the performance of the next milling operation applies in cases where the thread is on the outside of the work. For internal threading operations it will be obvious that the cutter-head must also be traversed along the bed of the machine to withdraw the cutter from the work so that the piece may be removed from the work-spindle. Provision for traversing the cutter-head in this way is made by means of a pinion *R* carried on the shaft *S* which meshes with a rack secured to the bed of the machine. A stop is provided on the bed for locating the cutter-head in the desired position when it is returned for the performance of the next thread milling operation. This longitudinal movement of the cutter-head is obtained by turning handwheel *T*.

The machine may be provided with a special hollow work-spindle so that external threading operations may be performed on long pieces of work of any size up to 1⅛ inch in diameter. With the regular spindle, the capacity of the machine is for work up to 4½ inches in diameter by 18 inches in length, although longer work can be handled by using a back-rest. Work larger than 4½ inches in diameter—of any size up to 17½ inches in diameter, which is the maximum swing of the machine—may be handled, provided its length does not exceed 8 inches, but large work of this kind must be of such a form that it can be driven from a center hole or in some similar way. Using a cutter of not more than 1 inch diameter, external threading operations may be performed on work up to 6¼ inches in diameter. Using a cutter 3 inches in diameter, internal threading operations may be performed on work up to 7¼ inches in diameter. An idea of the rate of production attained on this machine may be gathered from the fact that the threads are being milled on aluminum fuse bodies at the rate of 40 per hour; on this work the threaded portion is 1⅜ inch in diameter by ¾ inch long, and the thread is of the Whitworth type and 6 pitch. The principal dimensions of the machine are as follows: Length of bed, 3 feet, 10 inches; travel of cutter-head along bed of machine, 3¾ inches; floor space occupied, 3 by 6 feet; and approximate weight of machine, 2380 pounds.

NEWTON TORPEDO FLASK BORING MACHINE

The Newton Machine Tool Works, Inc., Philadelphia, Pa., has recently added to its line the torpedo flask boring machine, three views of which are shown in the accompanying illustrations. The claim is made that this machine has a capacity for doing work in 25 per cent of the time required by previous types of machines used for the same purpose. The outside of the flask that is to be bored is gripped by two revolving chucks which are rotated in unison by a common shaft. The boring-bar is held stationary and is equipped with tool-heads on each side which pass each other without interference. Each tool-head is provided with power feed along the bar and automatic release; and each head has adjustment in a direction at right angles to the axis of the bar, this movement being controlled by forms which conform to the contour of the flask that is being operated upon.

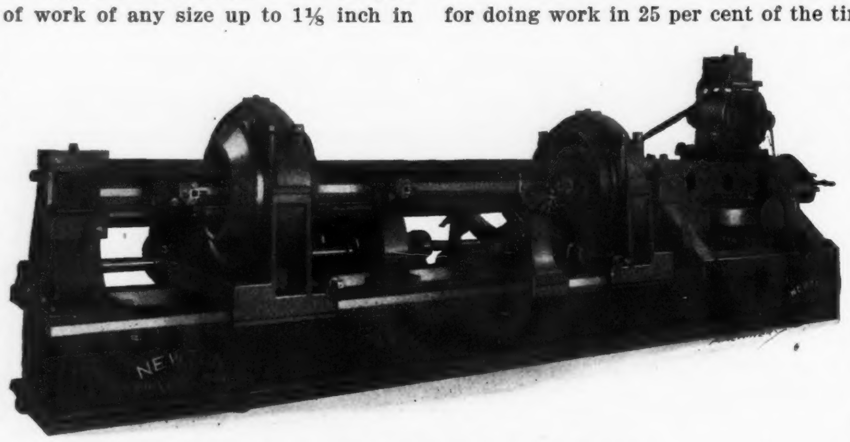


Fig. 1. Newton Torpedo Flask Boring Machine

The main head, on which the driving motor is mounted and to which the boring-bar is attached, has reversing fast power traverse on the base to permit of the insertion and withdrawal of the boring-bar after the flask has been located in the revolving chucks. When setting up the flask, the idea

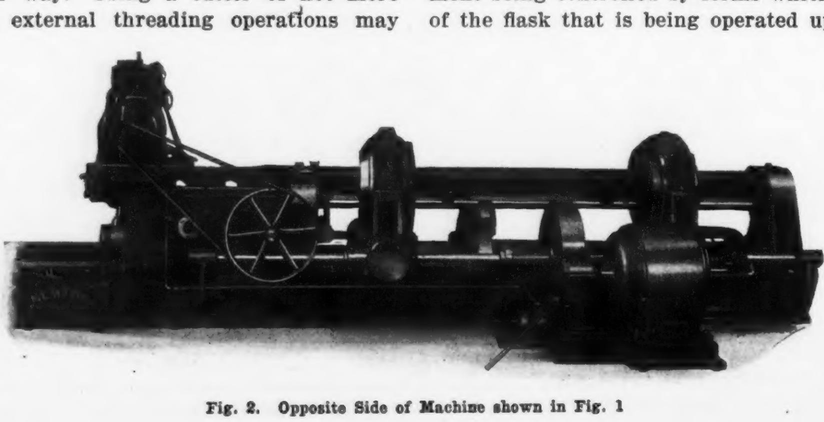


Fig. 2. Opposite Side of Machine shown in Fig. 1

is to traverse the movable head away from the stationary or end head, as shown in Fig. 3, in order to provide a distance greater than the length of the flask. The flask is then moved horizontally through the chuck on the stationary head and the movable head is adjusted back over the flask until it has been brought to the desired position. The chuck jaws are of a special broad design in order to prevent crushing the flask, which would occur if ordinary narrow chuck jaws were used for supporting the work. The machine occupies a floor space of 8 by 40 feet, and weighs 70,000 pounds.

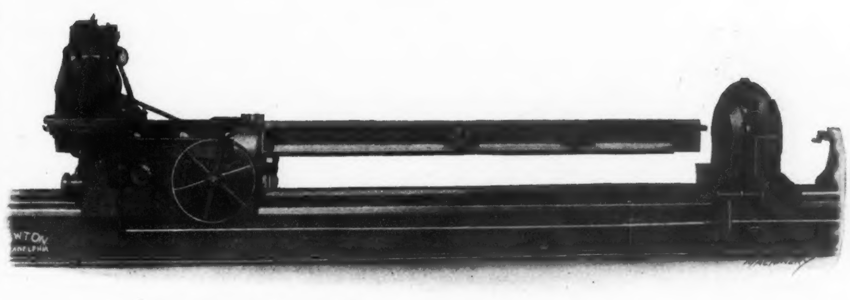


Fig. 3. Method of setting up a Flask on Machine

BRIDGEPORT WIDE-WHEEL GRINDER

To provide for the accurate and rapid grinding of cylindrical work up to 10 inches in diameter by 32 inches in length, the Bridgeport Safety Emery Wheel Co., Inc., Bridgeport, Conn., has added to its line a No. 106 grinder, three views of which are shown in Figs. 1 to 3. This machine is equipped with a wheel 20 inches in diameter by 8 inches face width, and if the piece to be ground is not over 8 inches long the work does not have to be traversed. This makes the machine suitable for using a shaped wheel for the performance of form grinding operations on pieces that come within its range. Work of more than 8 inches in length is traversed by means of a handwheel located at the center of the bed, the motion being transmitted through a rack and pinion.

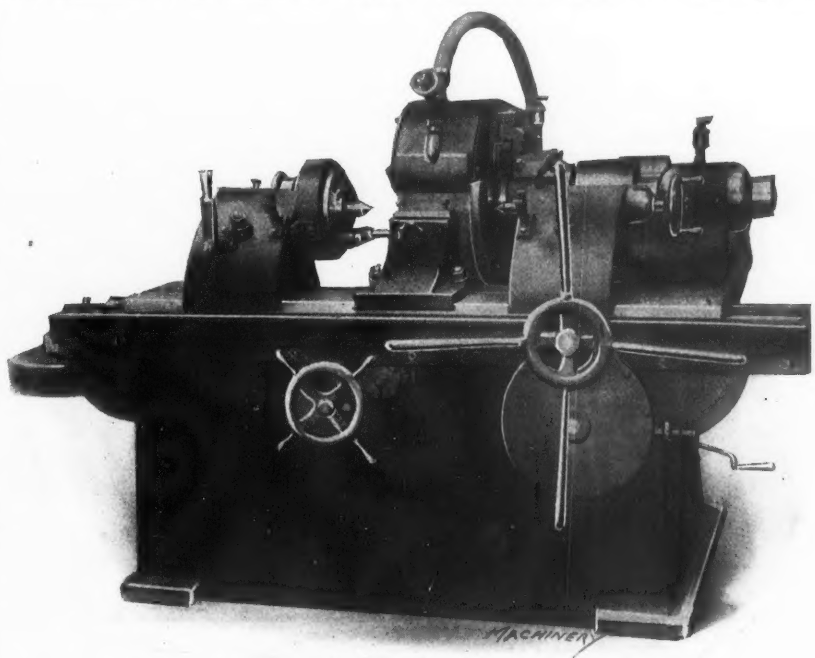


Fig. 1. Bridgeport Grinding Machine with Wide Faced Wheel

The work-table is mounted on flat ways on the bed, which is of the cabinet type; the top of the work-table has a wide flat bearing surface, and the top and front of the table are planed at right angles to each other, which provides means for securing the horizontal and vertical alignment of the headstock and tailstock. A channel is formed in the table casting along the front, rear and ends to provide for carrying away the drippings from the work to a water pan located at the rear of the carriage, and thence to the reservoir contained in a back extension. The bases of the headstock and tailstock have long bearings on the table, and the spindles are liberally proportioned. The headstock faceplate for driving the work is back-geared in the ratio of 3 to 1, and is provided with a long bronze bearing running on the spindle so that the work is supported on two dead centers. A hand-lever at the front of the headstock operates a clutch on the back-gear shaft to provide for stopping or starting the rotation of the work.

The grinding-wheel head is mounted on ways on an extension cast at the rear of the base. The spindle bearings are liberally proportioned and provided with the bronze taper sleeve construction employed on other machines of this company's manufacture; these sleeves are adjusted by screw collars at the ends. The bearings are lubricated by felt pads which receive oil from sight-feed cups. The grinding wheel is mounted between safety collars on a heavy spindle, and provision is made for accurately balancing the wheel by weights introduced into tapped holes in the loose safety collar. These features are clearly shown in Fig. 4. It will be noticed that eight bolts are provided for holding the safety collars together, and that these bolts are placed well out toward the periphery of the collars where they provide an effective pressure.

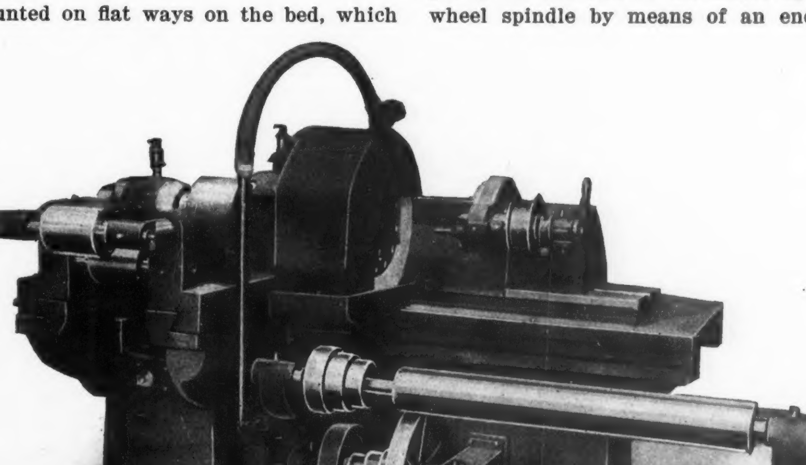


Fig. 2. Rear View of Machine shown in Fig. 1, equipped for Belt Drive

When individual motor drive is employed the motor is located at the back of the machine, and a pulley on one end of the motor spindle drives the grinding-wheel spindle by means of an endless belt. An automatic belt tightener and suitable idler pulleys take care of the changing conditions due to the wear of the grinding wheel and its forward and backward movement. On the opposite end of the motor shaft there is a pulley which drives a back shaft, and this shaft, in turn, drives the drum shaft; the drum is belted to the work pulley in the headstock. Three changes of speed are obtained by means of cone pulleys. The water pump is

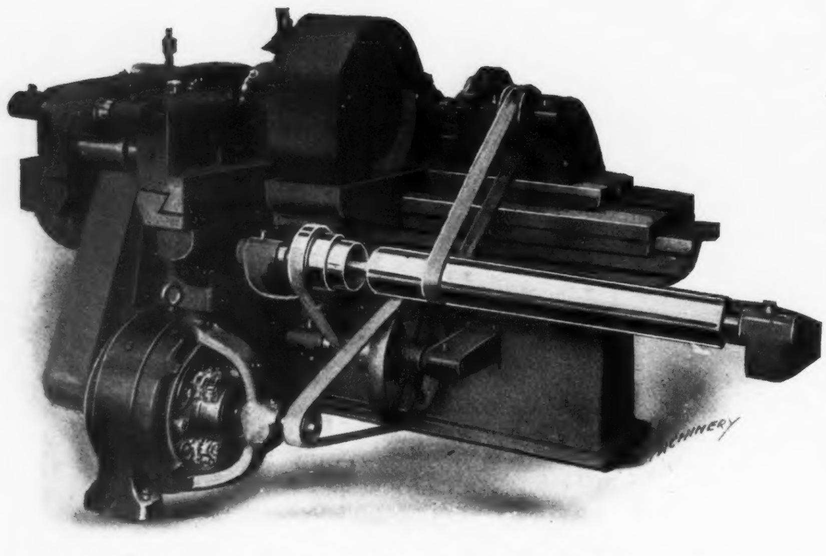


Fig. 3. Rear View of Machine shown in Fig. 1, equipped for Individual Motor Drive

driven from the back shaft, and both the back shaft and drum shaft are supported in bearings rigidly bolted to the main base.

The grinding wheel is fed to or withdrawn from the work by means of a pilot handwheel on the front of the base, which is back-geared to a lead-screw that engages a nut bolted to the under side of the grinding-wheel head. Outside of this lead-screw and concentric with it—but operated independently by means of a worm and worm-wheel—is an adjustable stop with micrometer adjustment which limits the forward movement of the wheel to the work. The object of employing a stop that is concentric with the lead-screw will readily be seen, as no side strain can be developed with its consequent change in the alignment of the grinding wheel.

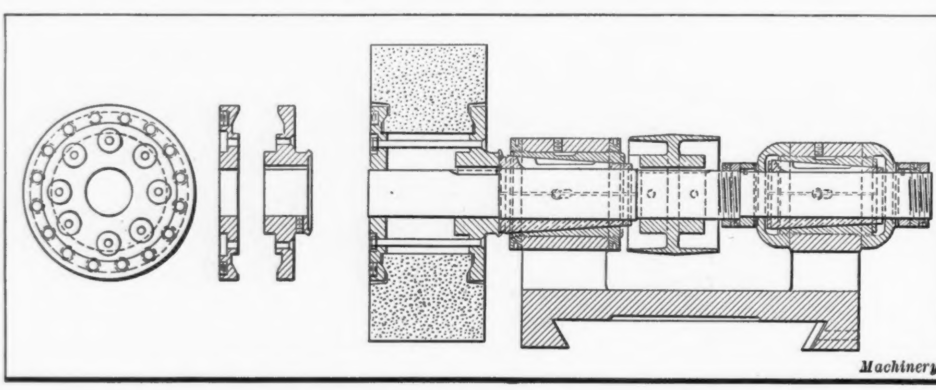


Fig. 4. Arrangement of Wheel-spindle Bearings and Mounting of Wheel on Spindle

The waste water and sediment are conducted through suitable channels to a removable pan, where the sediment settles and the water overflows into the main reservoir carrying little sediment with it. The pump takes its supply from this main reservoir. The principal dimensions, floor space, weight, etc., of the machine are as follows: Diameter of headstock spindle, 3 inches; diameter of tailstock spindle, 2½ inches; distance from top of table to centers, 8 inches; distance from floor to top of work-table, 32 inches; distance from floor to center of wheel-spindle, 40 inches; floor space occupied, 61 by 38 inches; and complete weight of machine packed and ready for domestic shipment, approximately 5500 pounds.

GENERAL ORDNANCE LATHE

The 22-inch heavy-duty single-purpose lathe which has recently been placed upon the market by the General Ordnance Co., Denver, Colo., was especially designed to meet the requirements of manufacturers of shrapnel and high-explosive shells, although this machine is also well suited for use in factories engaged in the manufacture of various other products. In order to provide the degree of rigidity in the headstock that is required for severe service conditions, the lower gear casing is designed to form connecting members between the front and rear main spindle and driving shaft bearings. The spindle is made from a solid steel forging and finished to size by grinding; it runs in renewable phosphor-bronze bearings which have exceptional resistance against wear. The thrust bearing is formed of alternate heat-treated steel and phosphor-bronze washers, and the driving gears on the spindle are cast steel with cut teeth. The driving shaft is also supported in bronze bushed bearings, and the two pinions are integral and splined to the shaft so that either may be brought into mesh by operating the hand-lever. The arrangement is clearly shown in Fig. 2.

The exceptional depth and width of the bed, combined with the internal bracing employed, insure rigidity under the heaviest cuts that can be taken with high-speed tool steel. The carriage ways are carefully fitted; they are of 90 degrees included angle with the tops rounded. To facilitate the quick removal of the tailstock or turret the bed is cut away at the rear end. The feed rack is in one piece and is made of steel. The carriage is heavily ribbed to provide the necessary rigidity, and the bearings are scraped to a perfect fit on the ways. The apron is shouldered into the carriage and has a bearing over its entire length; it is held in place by six screws. All the gears in the apron are made of steel and those which run on steel studs are bushed with phosphor-bronze.

The tailstock spindle is of large diameter and is constructed with a phosphor-bronze nut on a screw of medium pitch; the screw is operated by an unusually large handwheel which makes it an easy matter to drill holes of large diameter. Provision is also made for setting over the tailstock to provide for the performance of taper turning operations. The tailstock is moved along the bed by a removable pinion which engages the rack. The lead-screw is made of high-carbon steel with a chased thread, and the nut is of the split pattern. Thrust in both directions is taken by a bearing composed of heat-

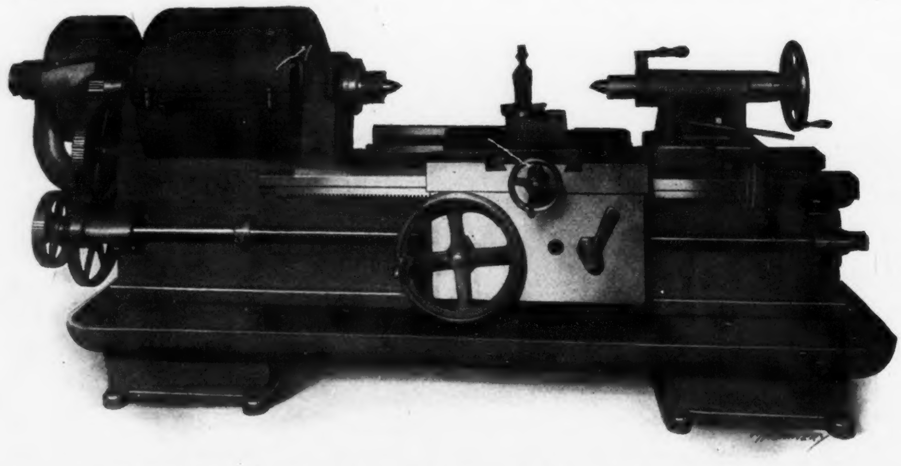
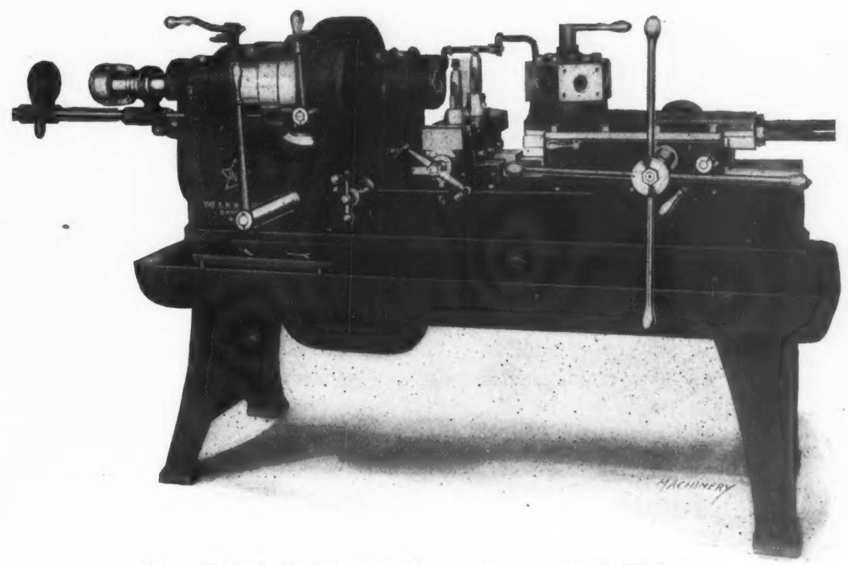


Fig. 1. Heavy-duty 22-inch Single-purpose Lathe built by the General Ordnance Co.

treated steel and phosphor-bronze washers. The equipment furnished with the machine includes a driving plate, change-gears, toolpost and the necessary wrenches. The following may be furnished as special equipment: A four-way toolpost, profiling attachment, waving attachment, collet chuck, steadyrest, standard faceplate, compound rest, combination toolpost and cross-slide, oil pan, oil pump and piping, boring-bar guide, and two-speed countershaft.

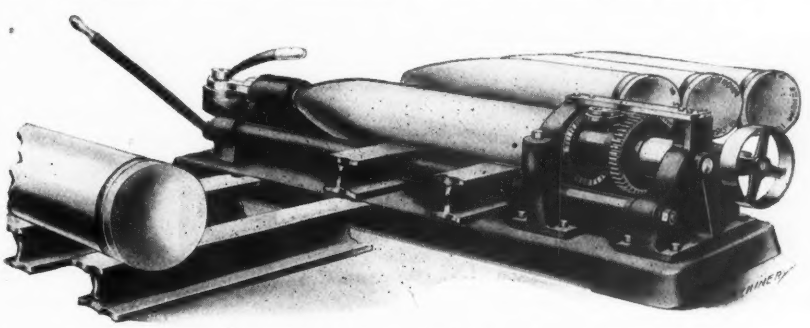
The principal dimensions of the machine are as follows: Swing over shears, 22 inches; swing over carriage 13¾ inches; swing over profiling carriage, 9⅛ inches; capacity between centers for a machine with an 8-foot bed, 3 feet 2 inches; maximum travel of tailstock spindle, 10 inches; number of changes of spindle speeds, 2; diameter of driving pulley, 20 inches; width of driving belt, 8 inches; height of centers above floor, 41½ inches; floor space occupied by machine with 8-foot bed, 4 by 11 feet; weight of same machine, 8000 pounds; and weight per extra foot of bed, 315 pounds.



"Star" 1½-inch Hand Screw Machine made by the E. H. Wachs Co.

LARGE NOBLE & WESTBROOK SHELL MARKER

The machine which forms the subject of this description, and which is shown in the accompanying illustration, has been developed by the Noble & Westbrook Mfg. Co., Hartford, Conn., for the purpose of marking the ends of large heavy shells. The machine is said to produce clean-cut impressions, and it can be successfully operated by unskilled labor.



Noble & Westbrook Machine for marking Base of Large Heavy Shells

In operating the machine, a rack is built on each side and the shells to be marked roll down this rack to the machine. Only a few seconds are required to complete the marking operation, after which the operator pulls a lever provided with cam adjustment, which raises the shell from the machine and allows it to roll away down the rack at the far side. At the same time, another shell drops into place ready to be marked. As no lifting of heavy shells is involved, the men do not become unduly fatigued and there is no falling off in the rate of production from this cause during the latter part of the day.

An important feature of the machine is that the die is constructed with each letter and figure a separate unit, so that any unit of the die may be replaced if it becomes worn or damaged, without the necessity of providing a complete new die. In the marking of heavy shells, this is the means of effecting a material saving. The machine runs by power, being equipped with a tight and loose pulley for belt drive; no countershaft is required. This marking machine is particularly intended for the marking of heavy shells, and the design has been worked out along simple lines, with ample strength provided to enable it to stand up under severe service conditions.

WACHS HAND SCREW MACHINE

The 1½-inch hand screw machine shown in the accompanying illustration is the latest product of the E. H. Wachs Co., 141-149 West Grand Ave., Chicago, Ill. This machine is equipped with a friction geared head, positive power feed to the turret slide, independent stops, an automatic chuck and wire feed, and an oil pump. The design has been worked out along lines which provide for the rapid production of accurate work.

Reference to the illustration will make it evident that all operating levers are located within easy reach of the operator. The machine is driven by a three-step cone pulley and back-gears, so that three direct and three back-geared speeds are available. Reverse is obtained through the countershaft. The collet has a capacity for work up to 1½ inch in diameter, and pieces of any length up to 9 inches can be turned. Stock of the full diameter capacity may be passed through the turret. The net weight of the machine, including the countershaft, is 2925 pounds.

It will be recalled that the E. H. Wachs Co. manufactured a hand screw machine some years ago, but the present tool has been entirely redesigned in order to produce a machine suitable for the requirements of modern factories. It is the intention to bring out other sizes of machines in order to make a complete line, and a building which is now in course of construction will be given over to the manufacture of these machines.

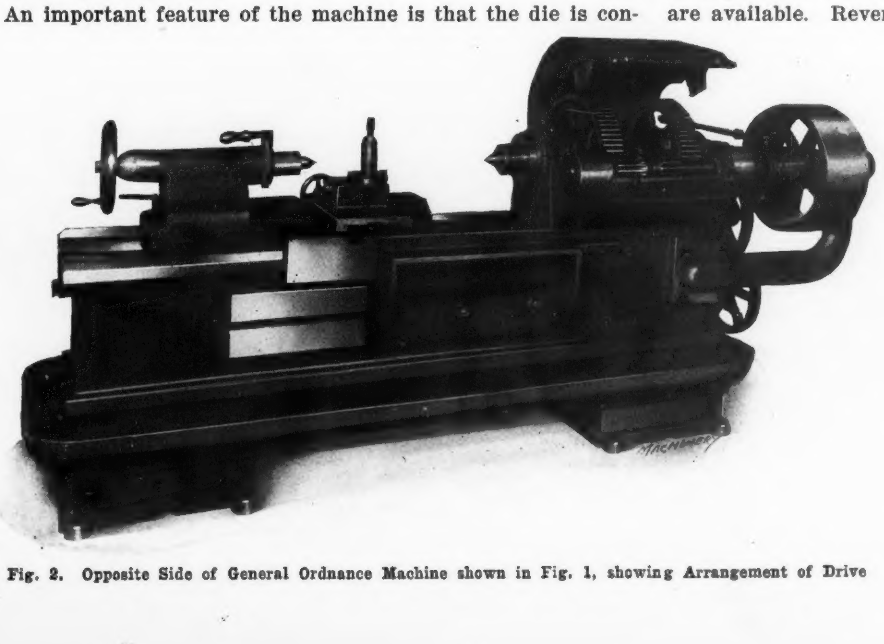


Fig. 2. Opposite Side of General Ordnance Machine shown in Fig. 1, showing Arrangement of Drive

THE SYMINGTON LINE OF SPECIAL SHELL MANUFACTURING MACHINERY

The Symington line of shell manufacturing machinery embraces a machine for each operation in making a given shell. All are single-purpose machines, intended for intensive production on munition work only. Features common to all these machines are: massive design, large spindles and generous bearings, simplicity of operation, which permits the employment of unskilled labor, and high productive power.

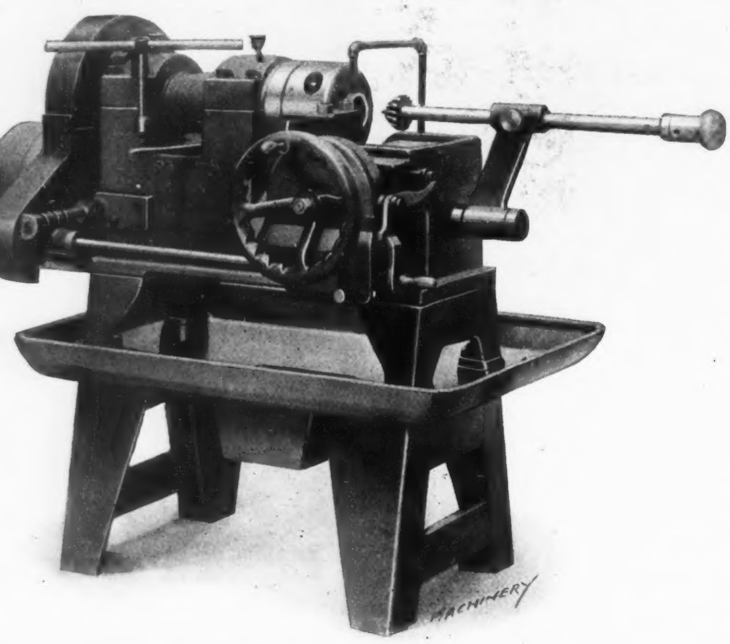


Fig. 1. Type A Shell Lathe as equipped for cutting off

The T. H. Symington Co., Rochester, N. Y., has recently perfected a line of shell manufacturing machinery suitable for the production of high-explosive or shrapnel shells of any size up to $3\frac{1}{4}$ inches (85 millimeters) diameter and 13 inches (330 millimeters) in length. They have been designed for covering all the machining operations on any type of shell within these size limits, whether made from bar stock or forgings. The line of machines includes means for performing every operation on the shell from the forging to the completed shell. It should be understood that these machines have been designed for the special purpose of shell manufacture, and in their present form are not intended for other operations.

The general characteristics of the entire line of machinery are extremely massive design and few working parts. These machines are very powerful and durable—more so than standard machinery could be for the production of miscellaneous work. Above all, they have been designed to be operated by unskilled labor, and are as nearly foolproof as it has been possible to make them. Being strictly single-operation machines, they will carry heavier cuts and coarser feed than standard machinery of much greater capacity. Each machine is furnished with single-speed drive, suited to the particular operation it is to perform. All machines are sent out tooled with the simplest and strongest chucks and tools possible. The line of machines and the operations they perform is graphically shown in the accompanying table which gives the types of machines used for the various operations. The number of machines handled per operator and the productions are also included. In all, there are five distinct types of machines in the line, and these are shown in the illustrations accompanying this article. For each operation, the machines are equipped with different chucks, tools, etc. The types are designated by letters and the equipment by numbers—thus the B-4 machine is the B type machine with No. 4 equipment.

The machines for shell turning proper are of two general types, known as types A and B. The type A machine, illustrated in Figs. 1 and 3, is used for the operations that are performed while the shell is held in a chuck or by other means not requiring a tailstock. These are cutting off, base-facing, wave-groove finishing, and band turning. On account of the nature of the operations, the machines do not require a traveling carriage, and hence it has been possible to make the design compact.

The type B machines are for turning and boring. This type of machine is of longer bed design and carries a power-fed carriage, as contrasted with the type A machine which has only a cross-slide. The type B machine is illustrated in Figs. 2 and 4, and is used for all outside turning and inside boring operations as indicated in the table. As these types are quite different in operation, they will be described separately.

In addition to these two general types of machines, there is the type W machine for nicking the open end of the shell, the type X machine for center drilling the closed ends of the shell, and the type H machine for the manufacture of fuse sockets, as shown in Fig. 5.

Cutting-off Machine—Type A-1

The Symington shell cutting-off machine, which is of the A type, is shown in Fig. 1. This is used for the single purpose of trimming shell forgings to length at the open end. It is provided with a very strong chuck of the hinged variety for holding the forging. The shell is pushed into the chuck with the bar gage shown at the right-hand end of the machine. The cutter shown on the end of the bar slides back out of the way. In locating in the chuck, spring pressure behind the shell must be overcome, so that there is no chance for misplacement. After locating, the hinged chuck is closed on the work, bringing the three gripping jaws tightly in place. The gage is withdrawn and the power feed is now thrown in and the $\frac{1}{4}$-inch wide cutting-off tool is fed in. This power cross-feed is secured from a shaft at the front that operates the large worm-wheel through a worm, and thus through the $1\frac{1}{2}$-inch lead-screw to the carriage.

A stream of lubricant is supplied to the cutting-off tool to enable it to withstand the heavy feed. An automatic throw-off is provided to disengage the feed as soon as the shell has been cut. After cutting the excess length from the shell, a cutter or burring tool on the gage, held in place by a removable pin, is thrust by hand pressure against the inside, and the cutting burr removed. To allow for any irregularities of the shell forging, the bracket through which the gage bar passes is bored large enough to allow a little play. It is claimed

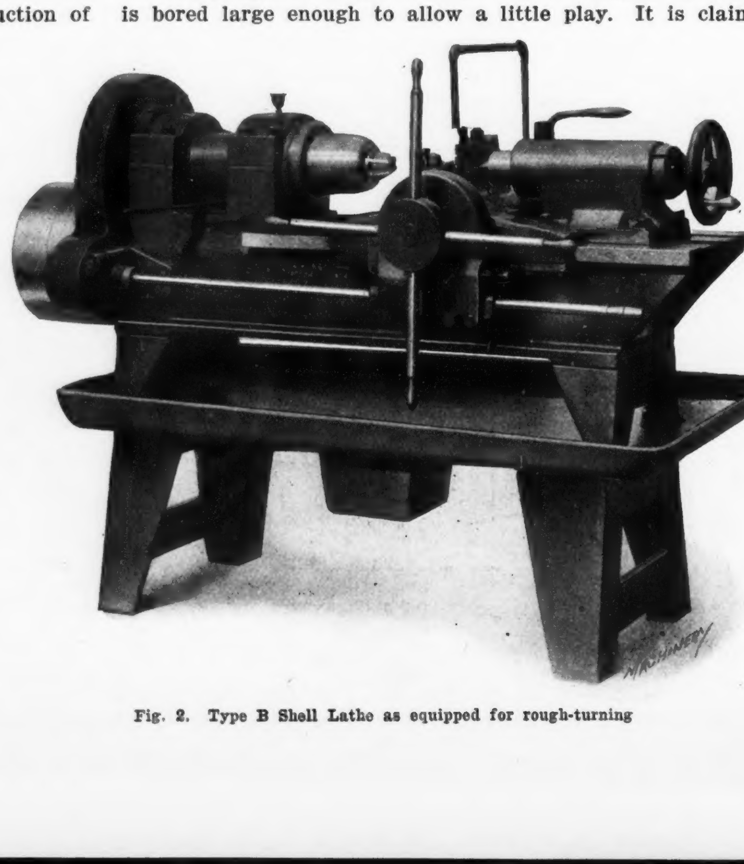


Fig. 2. Type B Shell Lathe as equipped for rough-turning

that this machine will exhaust the capacity of any steel cutting tool, and the production is fifty shells per hour from floor to floor.

Center Nicking Machine—Type W-1

There is a special machine for nicking the mouth of the trimmed forging to provide a means for driving during the turning operations. This machine (not shown) is a drop-hammer having a head weighing about 200 pounds. Mounted on the bed is the nicking tool, which resembles a short, stubby six-fluted taper reamer, except that the taper is extreme and the flutes have no cutting clearance. The shell is placed open end down on this tool and one drop of the hammer embeds the tool in the mouth of the shell, leaving six distinct nicks that provide means for driving as previously mentioned. For quick operation, a hand-lever trips the ram, so that the nicking operation may be done as rapidly as the shells can be handled.

Center Drilling Machine—Type X-1

Before going to the center drilling operation, the end of the forging is lightly faced off on a disk grinder. The machine for center drilling the closed end of the shell corresponds to the average 16-inch drilling machine. This is belt-driven and has but a single speed. The spindle carries a ¾-inch drill that operates through a bushing in a bracket supported from the column. On the base of the machine is the arbor upon which the shells are supported for center drilling. This arbor tilts forward from the bottom to allow the shell to be picked off or put on rapidly. The shell bottoms on the arbor, and before drilling, the operator presses a foot-treadle that expands three lugs at the top of the arbor and raises a tapered collar at the bottom that centers the open end of the shell. While the shell is held in this position, the lever feed is operated that brings the centering drill down into the work. The production from this machine is only limited by the rapidity with which the operator can handle the shells.

Rough-turning Machine—Type B-1

One of the most important of the machines of this line is the rough-turning machine shown in Fig. 2. This is a B type machine, and here, especially, the massive construction has been followed, and the six-inch diameter bearings are especially valuable. The shell is supported on centers, being driven by the six nicks in the open end that fit on a hardened

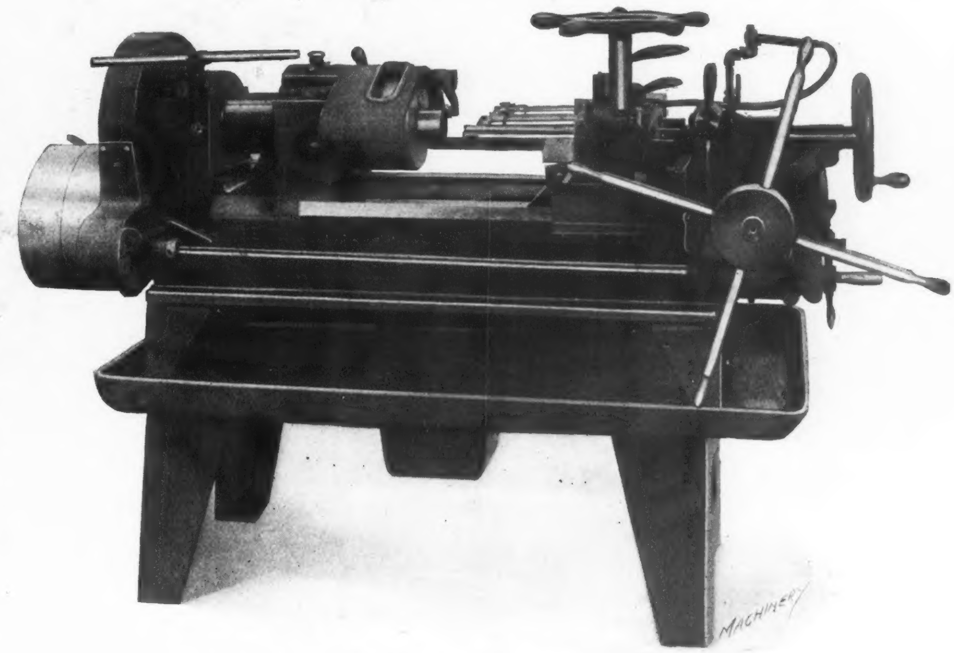


Fig. 4. Type B Shell Lathe as equipped for inside boring and reaming

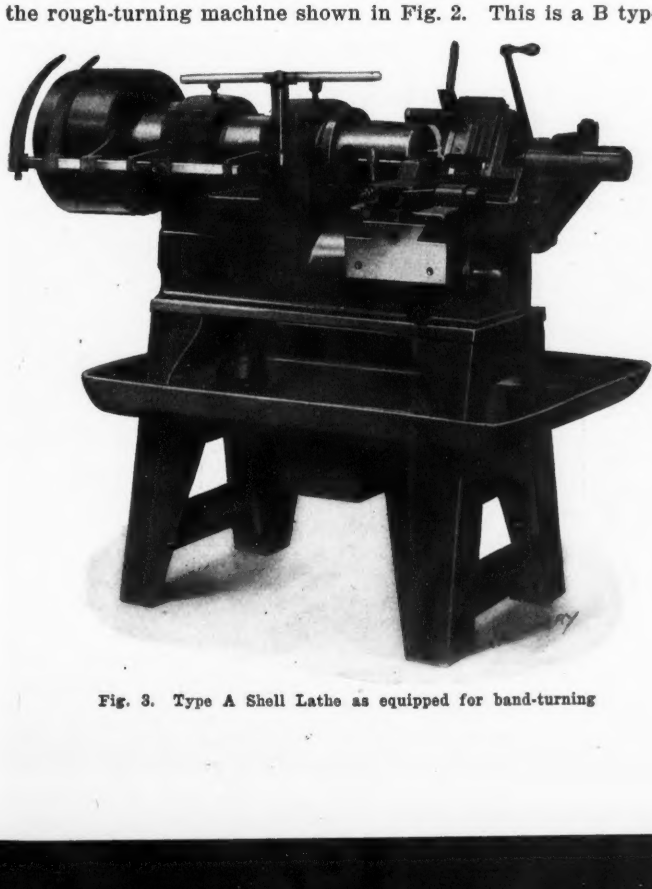


Fig. 3. Type A Shell Lathe as equipped for band-turning

and ground driving bit on the live center. An extremely heavy tailstock is provided, and the carriage that carries the turning tool is of more than ordinary weight and extremely long in its bearing upon the ways. These ways, it will be seen, are of the square type, and the carriage is fitted closely from both sides and bottom. The cutting tools are two in number, one being at the front and the other at the rear. The rear tool is set to cut slightly deeper than the front tool, so as to leave the shell turned to close limits when it comes from the machine. The carriage is driven from a rack at the center of the bed, operating through a worm and worm-gear. It is claimed that this machine will hold the diameter of the rough-turning to within one and one-half thousandth inch with reference to size and eccentricity, even though the shells be forged eccentrically. Shells may be handled on this machine at the rate of twenty-five per hour. The average feed used is 3/32 inch per revolution, but this can be increased if the nature of the shells warrants it.

Shell Boring Machine Type B-2

The next operation in shell production is the inside boring and reaming, and the Symington machine used for this purpose is illustrated in Fig. 4. While this is a B type machine, it differs from the B-1 machine in that there is a special carriage with a heavy cross-slide that corresponds to the turret of the ordinary turret lathe. This turret slide has three positions and is indexed by hand and locked in position by the locking-pin that may be seen near the center of the slide. The three operations that this machine performs are the profiling or boring of the inside of the shell from the nose to the diaphragm seat. In case the shell is not to be finished for the entire inside length, it is only necessary to finish the diaphragm seat. The next tool rough-bores and cuts the powder pocket and also the diaphragm seat. The third tool finish-reams the diaphragm seat and powder pocket.

Base Rough-facing Machine—Type A-2

The machine which performs the next operation on the shell is the A-2 machine. This is very similar to the A-1 type for cutting off, and its purpose is to rough off the back end of the shell, including the section that has been centered. The shell is placed within a hinged chuck and solidly clamped. In chucking, it is placed against a stop that reaches into the shell and gages the length from the bottom of the powder pocket. There are two tools used in the tool-block on the

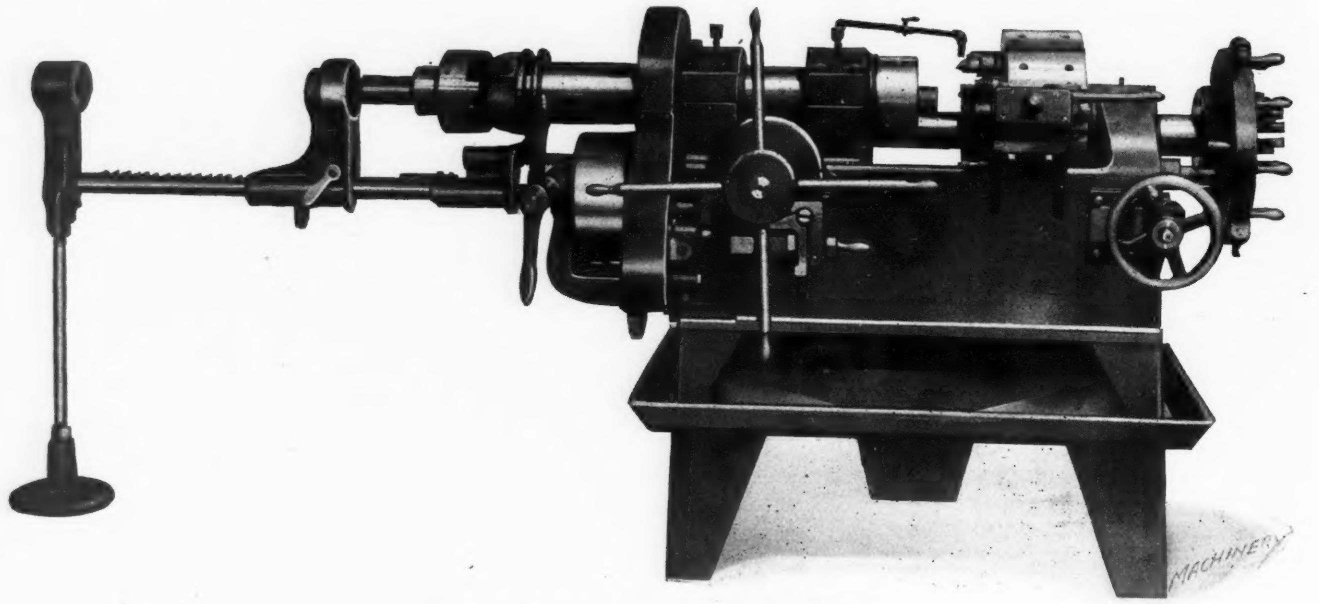


Fig. 5. Type H Semi-automatic Fuse Socket Lathe

heavy carriage; one removes the stock and the other takes off the corner of the shell. The carriage feed is through a shaft at the front, the same as in the cutting-off machine. An automatic stop is provided to throw off the cut when the operation has been concluded.

Shell Finish-facing and Forming Machine—Type A-6

The next machine in the Symington line is for finishing the face of the shell and forming it. This is very similar to the rough-facing machine, and is of the A type shown in Fig. 1. It has a positive stop for the movement of the cross-slide, and at the front are tools for facing the end of the shell, roughing out the band groove, cutting the crimping groove for the cartridge case, and rounding the corner of the shell. These tools are on the carriage and are fed to the work by hand.

Shell Waving and Undercutting Machine—Type A-3

A machine of the A type is used for waving and undercutting the band groove. The undercutting is done with special tools on the front carriage, operated by hand. The waving or knurling, as the case may be, is done from the back of the cross-slide. In the case of wave-cutting, the carriage is reciprocated by the action of a roll contacting on a cam-form on the chuck that holds the shell. In the case of knurling, it is simply drawn into the work until the right depth of knurling is secured.

Shell Nose-finishing Machine—Type B-3

The next machine in the Symington line is the finishing machine for the nose of the shell—a machine of the B type similar to the one in Fig. 4, except that there is no power feed, and the tooling equipment is held on a four-station turret slide. The chuck is also of a different type, being of a split-spring style that grips the shell centrally from the outside.

Shell Finish-turning Machine—Type B-4

For finish-turning the outer diameter of the shell after heat-treatment, a machine of the B type is used. This machine has a heavy tail-block provided with a quick-acting center. A screw-plug center is put in the open end of the shell and the dead center engages this for support, while the finish closed end is held in a spring chuck. The machine carries but one cutting tool and this has a feed of 1/64 inch per revolution at the start, which is made at the nose end of the shell. This, it will be remembered, is a formed shape, and in order to secure it, a profiling fixture at the back of the machine is used to guide the tool. This is of the ordinary type, having a hardened cam, against which a roller on the carriage is drawn by a heavy spiral spring. After the nose section has been turned, the feed is automatically increased to 3/64 inch per revolution; this is maintained until the band groove is reached, which is the end of this cut. An automatic throw-off is fitted for dropping the feed at the end of the cut. At this point in the shell making the band is pressed in place.

Shell Band Turning Machine

The final machine in the Symington line is the band turning machine illustrated in Fig. 3. This machine is of the A type, but carries very interesting tooling which makes it quite different in its operation. The closed end of the shell is gripped in the chuck on the spindle. The cross-slide is of compound design, having a tool at the front that is fed in to trim the edges of the copper band; this tool does not form the band, however, the band-forming operation being done by the formed tool on the inclined slide at the rear that is fed down with a lever feed. After the band has been brought

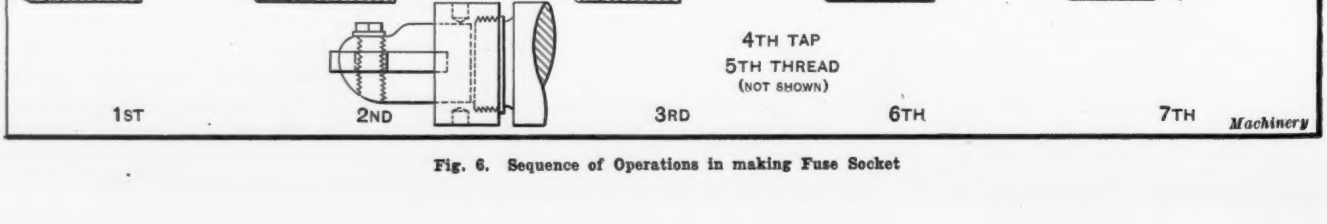
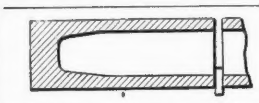
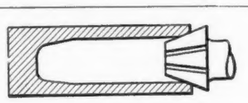
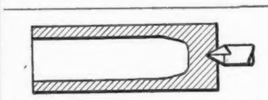
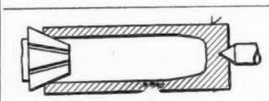
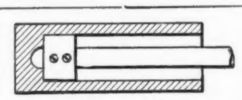
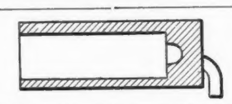
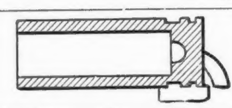
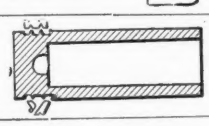
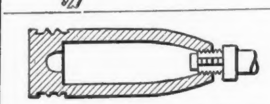
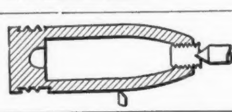
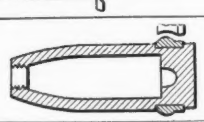
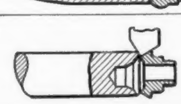


Fig. 6. Sequence of Operations in making Fuse Socket

to the right width and the face has been properly formed with the inclined tool, a third tool located on the top of the inclined slide is brought over with a hand-lever. This is merely a scraping tool that cleans off the last vestige of copper band that may be clinging to the sides of the shell. This completes the machining of the shell.

The Symington machines may be obtained singly or can be furnished in unit batteries, consisting of the right number of machines for balancing up the different operations.

TABLE SHOWING OPERATIONS IN MAKING A TYPICAL SHELL ON SYMINGTON MACHINES, WITH NUMBER OF MACHINES PER OPERATOR AND PRODUCTION

	Oper. No.	Operation	Type Mach.	Mach. per Oper.	Prod. per Hour
	1	Cut Off	A 1	1	50
	2	Nick Center	W 1	1	300
	3	Center Drill	X 1	1	200
	4	Turn on Centers	B 1	2	25
	5	Finish Inside	B 2	1	10
	6	Rough-face Base	A 2	1	35
	7	Finish-face and Form	A 6	1	30
	8	Wave and Undercut	A 3	1	25
	9	Bore, Ream and Tap Nose	B 3	1	30
	10	Finish-turn	B 4	2	10
	11	Turn Band	A 4	1	60
	12	Make Adapter	H	1	12

Machinery

Symington Fuse Socket Machine

In addition to the machines for the production of shells, the Symington line includes the machine shown in Fig. 5, which is known as the type H machine and is for producing fuse sockets for 3-inch shells. This machine, in common with the other machines in the line, is a single-purpose machine, although it can be adapted to the production of any parts of similar size and shape. Fig. 5 shows the machine as viewed from the rear.

The features of the machine are its extremely heavy spindle and other working parts. This insures great rigidity. The machine operates on a bar of 2 11/16-inch cold-rolled steel that passes completely through the hollow spindle. The cutting tools are mounted in a heavy turret that has, in the present instance, seven stations. Any lateral feed necessary is secured by rotating the turret on its axis as will be more fully described later.

The main spindle of the machine is mounted in bearings 6 inches long, and as the spindle is 6 inches in diameter it will be seen that the spindle support is very generous. The spindle is ground to size and runs in babbitt bearings, bored and scraped. A 3¼-inch hole runs through the spindle from end to end, thus providing for carrying stock up to 3⅛ inches diameter. For the present job, steel 2 11/16 inches diameter is used and is held by a spring collet with tapered nose that is closed by being pushed into a taper sleeve, just as in general screw machine practice. The stock is fed and the chuck opened and closed by hand from the front of the machine. This is a ratchet type of stock feed and similar to that used on several standard hand screw machines.

The Turret

The turret shaft is behind and below the main spindle, and so located that the spindle line and the turret line are at an angle of thirty degrees from the horizontal. The forward feed of all tools is secured by advancing the turret shaft, turret and tools. The drive of the machine is from a two-speed countershaft, down to a 5-inch face pulley on the stock feed shaft below the spindle. Integral with this pulley, is the drive pinion that engages the gear on the spindle and thus furnishes the drive.

On the turret are seven tool stations placed at various distances according to the space required for the tools for each station. All seven tools, however, are spaced within an arc of 270 degrees so that the rest of the space is left clear for chip room. The indexing is done by hand, using the handles on the turret stop disk at the extreme right-hand end of the machine as viewed in Fig. 5. The turret is locked at each station by a wide tongue on the bracket at the front and the engagement of this tongue in a slot in the turret locks it in position. The slots in the turret are fitted with hardened steel inserts. The locking tongue is withdrawn with a hand-lever, and when in engagement is held with a stiff spiral spring. The turret stop disk also carries stops for limiting the turret travel for each station. While the turret shaft power feed is used for bringing the tools up nearly to the limit of their cut, the hand feed is used for finishing each cut. The extreme length of turret travel is seven inches.

The tools are located around a 13-inch circle. For certain of the operations, where forming or recessing tools are to be used, it is necessary to give the tools lateral feed. This is accomplished by rotating the turret slightly, thus carrying the tools sideways for the cut. In making this fuse socket, three of the seven operations require side travel of the tools. On the inner face of the turret disk are three one-inch steel pins, each two inches long. One of these pins is shown in Fig. 5. At the time of indexing for one of these side feeding operations, the locking tongue, instead of dropping into the deep slot in the turret, drops into a shallow groove, the function of which is to engage the tongue, and lightly hold the turret in position while the tools are entering, but permits the tongue to slip out when the turret is turned. The pins in the turret disk, previously described, engage in a hole in the side of the turret operating slide at the extreme right of the machine. This carriage is operated by hand, and by reciprocating it the pin connection to the turret disk causes the turret to turn and the tools to describe an arc in the work. The limit of rotation is reached when the set-screws on the edge of the turret disk strike the square stop stud that extends from the frame of the machine.

Tools

The operations in making the fuse socket are shown in Fig. 6, and after feeding the stock are: first, rough-drilling with a two-diameter drill; second, boring inside to size; third, internal necking and outside forming; fourth, tapping; fifth, cutting external thread with die; sixth, finishing the taper seat with internal tool; and seventh, forming outside and cutting off.

On the third, sixth and seventh operations, the cross-feeding

operation just described is necessary. A lubricant pump at the rear of the machine carries oil to the cutting tools. This machine will turn out fuse sockets complete from bar stock at the rate of twelve per hour.

SHEPHERD-PRINCE "MASTER" WRENCH

The "Master" wrench which is a recent product of the Shepherd-Prince Co., Inc., 18 E. 41st St., New York City, has been designed in such a way that it works equally well on square or hexagonal nuts and pipe or other cylindrical pieces, adjusting itself for all different sizes which come within its range. It will be noticed that the wrench is composed of only two parts and these cannot become separated. This wrench is made of drop-forged machine steel and finished in black enamel and polished steel.

In applying the wrench to a nut, it is held with the head down to allow the sliding jaw to drop to the position which

Shepherd-Prince "Master" Wrench for turning Square, Hexagonal and Round Nuts and Fittings of Various Sizes

gives an opening of the maximum width. The wrench is then pushed forward until the nut or other part to be turned engages both jaws. To tighten a nut or pipe fitting, the wrench is held with the sliding jaw at the top; conversely, the loosening of a nut is done with the sliding jaw at the bottom. On each side of the wrench there is a small arrow which indicates the proper direction in which to turn the wrench when in either of these positions.

XANDER UNIVERSAL ELECTRIC TEST INDICATOR

The universal electric test indicator illustrated and described herewith is in reality an attachment for the standard surface gage used by machinists and toolmakers. Its purpose is to save the operator from eye strain while watching for the contact of the surface gage needle with the work which is being trued up. With this tool, the moment the ball point of the needle touches the highest point on the work, either internal or external, an electric light flashes in the end of the tube, thus indicating the direction in which the work

Fig. 1. Xander Electric Test Indicator mounted on Surface Gage

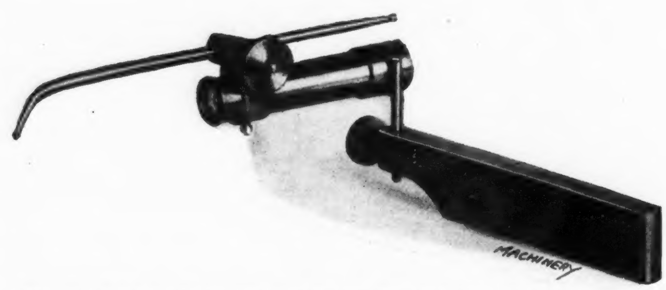


Fig. 2. Xander Electric Test Indicator provided with Holder to mount in Toolpost

must be moved. When a perfectly true position has been obtained, the light will burn continuously.

This indicator is extremely sensitive, as the lightest touch of the needle with the work will cause the electric light to flash. The tool is self-contained, the electric battery being enclosed in the main body of the indicator so that it can be connected with the electric light bulb without requiring the use of external wires or connectors of any kind. The battery can be renewed at small expense, but it has a capacity for several months' hard service before it is worn out. A holder is furnished for use with the indicator, which provides for mounting it in the toolpost of a machine in cases where it would be inconvenient to use a surface gage. This tool has been developed by J. G. Xander, 30 N. 9th St., Reading, Pa.

SCHATZ UNIVERSAL ANNULAR BALL BEARING

An annular ball bearing which is capable of sustaining a thrust load equal to 50 per cent of the rated radial load in either direction and without adjustment, has recently been developed by the Schatz Mfg. Co., Poughkeepsie, N. Y. This bearing is known as the Schatz universal annular ball bearing, and its ability to withstand end thrusts is due to the arrangement of the outer race which provides two points of contact for the balls. As a result, the balls have three points of contact, two of which are in the outer race rings and the third in the inner race ring.

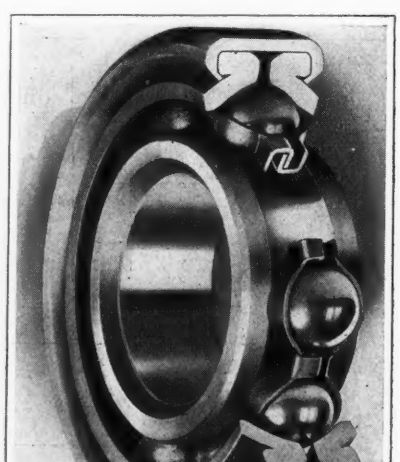


Fig. 1. Schatz Universal Annular Ball Bearing

The outer race is made in two parts, each of which has a curved recess generated on the inner periphery to form the raceways for the balls. This explains how each ball obtains a two-point contact on the outer race. The usual form of ball track is generated on the outside of the cone or inner race ring, and is designed to provide precise co-axial rotation. The curvature of the raceways is 4 per cent greater than that of the balls, so that a theoretical point contact is secured. The two points of contact on the outer race are so arranged that lines drawn through them and intersecting at the center line of the bearing form equal angles with the center line of the bearing. The contact point on the inner ring is located on the center line of the bearing, and the three-point contact provided affords a triangular support, the resultant of which is in a direction that enables the high thrust loads to be carried. The condition will be understood by referring to Fig. 2. Although this cannot properly be called a thrust bearing, the capacity for thrust loads is sufficiently high so that in many cases it is

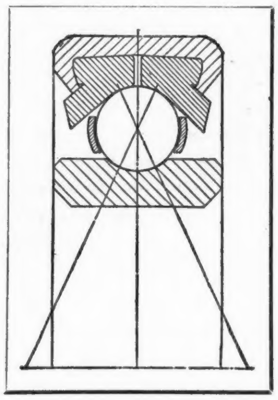


Fig. 2. Diagram of Contact Points of Balls on Races

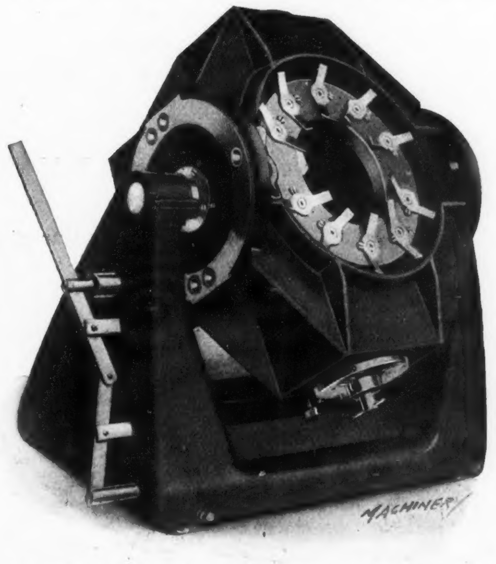
unnecessary to provide a separate thrust bearing.

The outer race rings are a pressed fit in the case, and after assembling, the case is closed over the rings, thus fixing the relative positions between different parts of the bearing. The ball separator is made of pressed steel and is of a self-locking design which does away with the necessity of using rivets. The principle upon which the separator is constructed allows the maximum number of balls to be used, and also supports them upon their axes of rotation or at the points of minimum friction and wear. The accuracy of the balls is checked to be sure that they come within limits of 0.0001 inch, and the surface finish is carefully inspected to insure smooth and quiet running. All parts are made of high carbon chrome alloy steel with the exception of the case and ball separator. The dimensions of the bearings, such as the diameter, width, bore, etc., are in accordance with international standards, so that the bearings are interchangeable with those of other makes. S. A. E. standards are used throughout.

BOX DRILL JIG FOR REAR AXLE HOUSINGS

The Gem City Machine Co., Springfield, Ohio, has recently developed a box drill jig for use in drilling, reaming, tapping, chamfering and spot-facing holes in automobile rear axle housings. It will be seen from the illustration which accompanies this description that the jig swings on trunnions fitted in the cradle or base, and that the base is equipped with index pins for locating the jig in any of five positions. There is an index pin at each side of the base and these pins are operated simultaneously by a single hand-lever.

The rear axle housing is put in the jig through an opening covered by a hinged and latched lid; and the work is held in



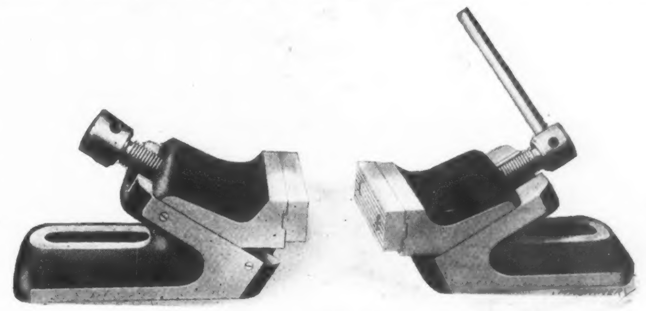
Gem City Box Drill Jig for Use in machining Automobile Rear Axle Housings

place by means of hardened steel plugs which insure positive location. All parts of the jig which are subject to wear are hardened and ground to size, thus greatly reducing the possibility of inaccuracy of the work as a result of wear. At the bottom of the jig there is an interchangeable plate which has one direct and one angle hole. This plate may be interchanged from one end of the jig to the other and gives a positive location of the holes. The weight of the tool is 1100 pounds and it is equipped with rollers carried by hardened and ground steel pins. These rollers run on tracks which carry the jig under the machine and also enable it to be easily run back to remove the work.

SCHUCHARDT & SCHUTTE DIVIDED MACHINE VISE

To save time which is often lost in looking for suitable straps to secure a piece of work to a machine table, and to extend the capacity of the machine vise so that it will hold work of any size, Schuchardt & Schütte, 90 West St., New York City, designed the divided machine vise shown in the accompanying illustration. It will be seen that although the gripping surfaces of the jaws are vertical, their supporting bearings are inclined downward, and when the jaws are tightened up on the work this downward inclination overcomes any possible tendency of the work to rise from the table. As a result, it is unnecessary to resort to the practice of hammering the work down into place after it has been clamped on the platen.

It will be evident that while the two parts of this tool constitute the equivalent of a standard machine vise, the divided



Schuchardt & Schütte Divided Machine Vise

construction enables the two parts to be secured to the platen in suitable positions to accommodate any size of work that comes within the capacity of the machine on which the vise is used. By setting the jaws at the required angle, this divided vise may also be employed for holding tapered or angular work. It will also hold thin plates without danger of distortion. This vise is suitable for use on planers, milling machines, shapers, slotters, drill presses, and all other types of machine tools provided with tables having the usual arrangement of T-slots for clamping down the work.

PEERLESS HIGH-SPEED HACKSAW

The Peerless high-speed hacksaw built by the Peerless Machine Co., 1611 Racine St., Racine, Wis., is designed to operate at a speed of 250 revolutions per minute. Working at this rate it is suitable for cutting low carbon steel, soft

Fig. 1. Front View of Peerless High-speed Hacksaw

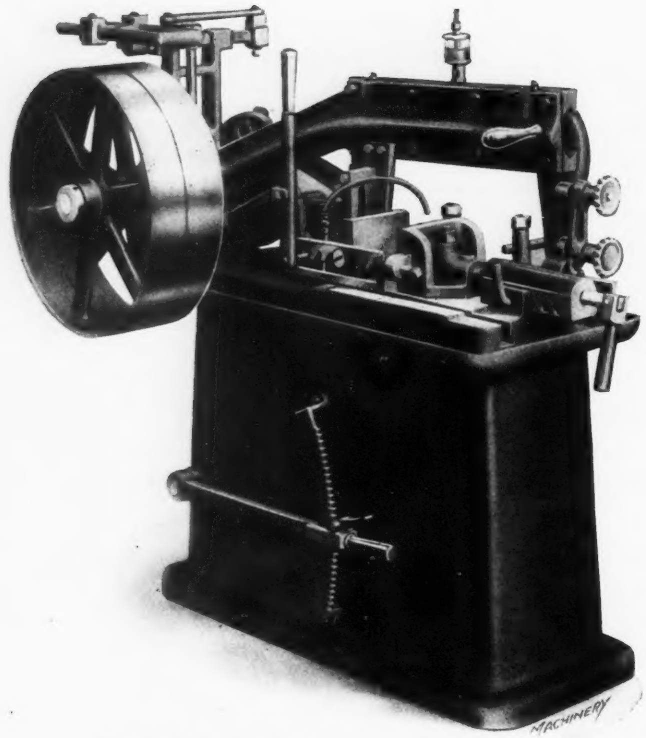


Fig. 2. Opposite Side of Hacksaw shown in Fig. 1

metals of numerous kinds, fiber, hard rubber, and a variety of other materials. The machine is built for both heavy and light work, and it will be evident from the illustrations that ample strength is provided for severe conditions of service; but the machine is so sensitive that common blades 8 by ½ by 0.027 inch in size, of the kind used in hand frames, can be successfully driven when the machine is running at a speed of 125 revolutions per minute. At this speed, 1-inch round cold-rolled steel can be cut in less than one minute. Tests have also been conducted to determine the possibility of cutting sheet steel 1/16 inch thick, that is one of the most severe tests to which the sensitiveness of the machine could be subjected, and the results of such tests are said to have been favorable. The use of thin blades results in a substantial saving of the amount of material wasted by each cut, and this is a particularly important consideration at the present time, owing to the scarcity and excessive cost of high-speed steel.

It will be seen that the frame of the machine is of the cabinet type which affords ample strength and avoids danger of springing the machine in cutting heavy work. The bottom of the cabinet forms a tank for the cutting compound, and the pump is located inside of the cabinet where it is out of the way. The cutting compound and chips are collected in a separate pan located just inside of the door in the cabinet; the chips are held in this pan and the cutting compound escapes into the reservoir. A point should be made of emptying the chip pan every morning when all the cutting compound has drained off from the chips, leaving them dry, as this is the means of saving cutting compound and of insuring uniform operation. The saw blade travels on the center line of the saw guide and connecting-rod, so that there is no chance for any side pull. The blade is secured by a clamping device which holds it at each end with straight hardened steel pins; and the saw tightener is designed in such a way that it also provides for holding saw blades of various lengths. The table has T-slots at each side of the vise by means of which irregular-shaped work can be clamped. The vise is of the quick-acting type and has a screw adjustment of 1 inch, the screw being enclosed to protect it from damage when setting up heavy bars on the machine. A quick-acting attachment is used when cutting flat pieces, which prevents the jaws from tilting.

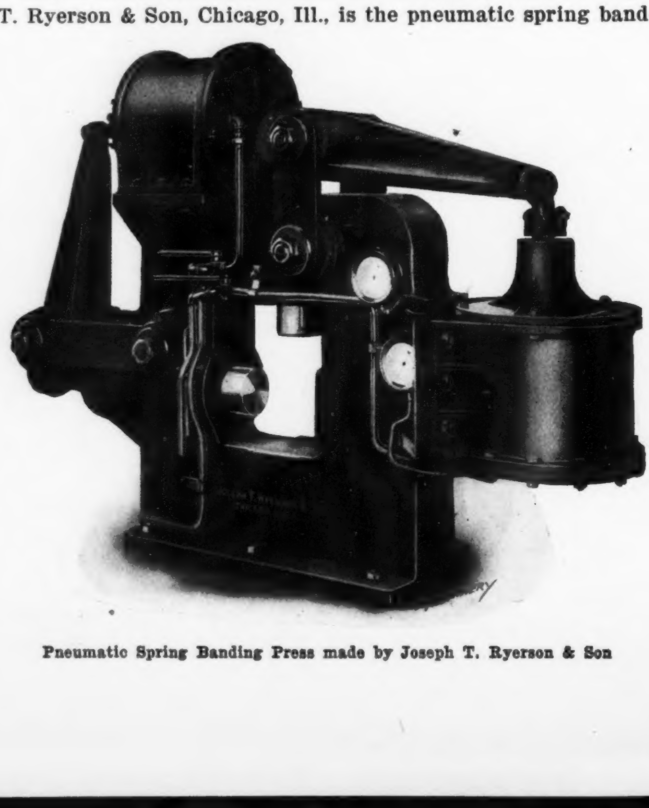
The feed mechanism is operated by a spring which is so arranged that it has exactly the same effect as if a weight were employed; the feed pressure may be instantly changed by means of a lever located at the left-hand side of the machine. When this lever is down, there is no pressure on the blade, and with the lever in the top notch the feed pressure on the blade is 125 pounds. The blade is automatically lifted from the work on the idle stroke by means of a spring, and there is a cam on the main shaft which only allows the feed pressure to act on the cutting stroke. At the end of the cutting stroke the cam releases the feed pressure and the frame is automatically raised to clear the blade from the work until the end of the idle stroke is reached. The action of the mechanism is entirely positive, making it impossible for either the feed pressure to be applied or the blade to drag over the work on the idle stroke.

The feed mechanism is controlled by the belt shifting lever. When the belt starts to shift, the machine commences operation, but the feed does not come into action until the belt has been shifted through three-quarters of its movement. At this point the feed mechanism is thrown into action. In starting to cut on a square corner, when using the extreme feed pressure and a coarse tooth saw blade, it is advisable to take hold of the handle of the saw guide and allow a light feed pressure to be applied on the cutting stroke until the square corner of the work has been removed; otherwise there may be danger of breaking the teeth of the saw. An alternative method of doing the same thing consists of releasing the feed lever at the left-hand side of the machine, so that there is absolutely no pressure on the feed, and then slowly raising the lever so that the pressure is gradually applied to the blade. In this way the most delicate piece of work can be cut, as any desired feed pressure may be instantly obtained.

In case the saw blade should break, the saw frame cannot drop. Should the blade break, the rate of feed is increased until a position is reached corresponding to the completion of the cut, at which point the machine is automatically stopped in the same way as if the blade had not broken. As the feed mechanism is controlled by the belt shifter, the feed is always released before the machine stops. A height gage may be provided for cutting any size of work, and the gage can be set so that the frame is always brought into position ready for the next cut. All that is necessary is to loosen the vise, shift the stock, and commence taking another cut. The machine is also provided with a depth gage for automatically stopping it at any desired depth of cut; when stopped, the saw frame automatically rises to the starting point, which saves a considerable amount of time in preparing for taking the next cut. When a number of machines are being looked after by one man, the raising of the saw frame serves as a signal to notify him that the cut is completed.

RYERSON PNEUMATIC SPRING BANDING PRESS

One of the recent additions to the machinery line of Joseph T. Ryerson & Son, Chicago, Ill., is the pneumatic spring band-

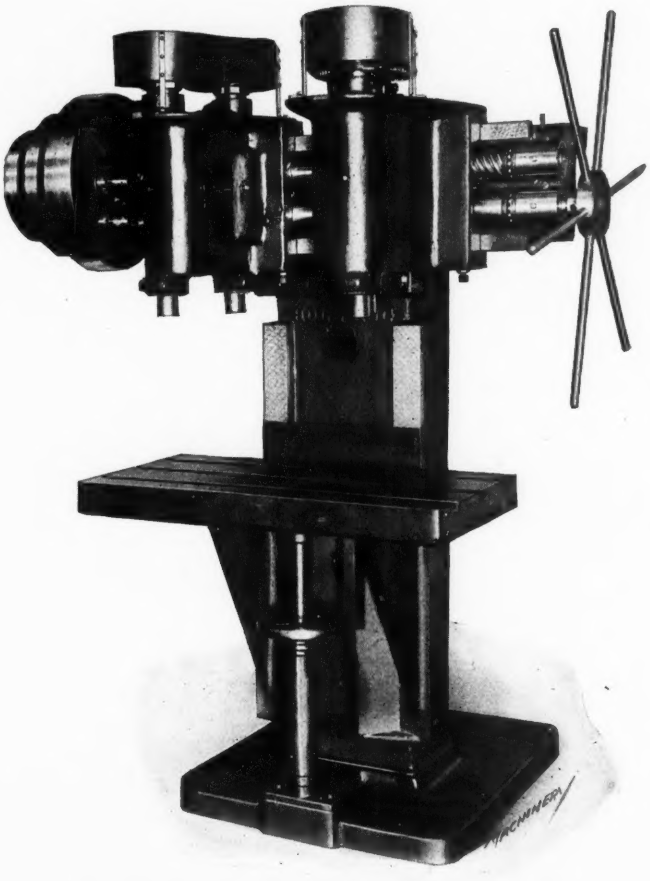


Pneumatic Spring Banding Press made by Joseph T. Ryerson & Son

ing press illustrated and described herewith. This press is particularly adapted for railroad and commercial spring manufacturing and repair shops that are not equipped with hydraulic power. The air cylinders are of such a size that with compressed air at a pressure of 100 pounds per square inch, a pressure of 60 tons is exerted on the rams. By means of both horizontal and vertical rams a positive pressure of predetermined intensity is exerted on the spring band which insures uniform results and a rapid rate of production. Each machine is furnished complete with three-way hand-operated valves and pressure gages. The weight of the press is 6500 pounds.

MOLINE HIGH-SPEED MILLING MACHINE

The four-spindle vertical milling machine which forms the subject of this description is a recent product of the Moline Tool Co., Moline, Ill. Reference to the illustration will make it evident that the design embodies a number of the same principles employed in the construction of multiple spindle drilling machines of this company's manufacture. The spindles are driven by the standard Moline spiral gear drive, and the heads are traversed toward or away from each other by

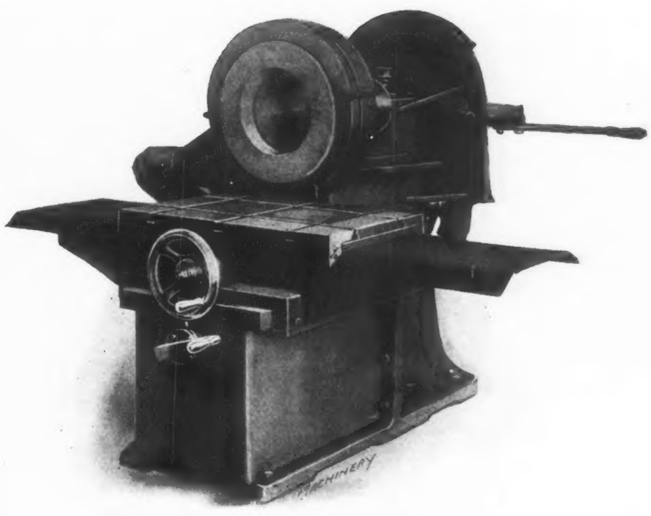


High-speed Milling Machine built by the Moline Tool Co.

right- and left-hand cam grooves in a shaft located below the drive. Only hand feed is provided, as the machine is intended for light work, and quick operation is the point of greatest importance. The table is provided with T-slots and may be made plain or with oil grooves as required. Machines of this type can be built with special heads and equipped with any desired number and arrangement of spindles to meet the requirements of the work.

GARDNER DISK AND RING-WHEEL GRINDER

The Gardner Machine Co., Beloit, Wis., has recently added to its line a combination disk and ring-wheel grinder which has been developed from the regular No. 6 Gardner machine. The special feature consists of the provision of a work-table at the left-hand end of the grinder; the top of this table is 20 inches wide by 30 inches long, and it is provided with the



Gardner Special No. 6 Combination Disk and Ring-wheel Grinder

usual form of T-slots for securing the work or fixtures in place. The table has a longitudinal travel of 20 inches, which is obtained by turning a handwheel at the front of the machine. This handwheel rotates a shaft and pinion which meshes with a rack attached to the under side of the table. The feed toward the wheel is actuated by a finely threaded screw which carries a crank, the length of travel being 6 inches. All parts of the mechanism which are subject to wear have guards which provide for the exclusion of dust and grit.

The machine is equipped with an 18-inch abrasive ring wheel held in one of the Gardner "Perfection" chucks; and the work to be ground is mounted on the table and fed over the wheel in the usual way. The right-hand end of the spindle is equipped with a 26-inch abrasive disk wheel. A universal lever feed table provides for holding the work ground by this wheel. Both the disk wheel and ring wheel are enclosed in dust hoods that are connected to an exhaust system at the rear of the machine. The spindle is 2 inches in diameter and the driving pulley 8 inches in diameter with a face width of 8½ inches. The equipment of the machine includes a 26-inch disk wheel press and the countershaft.

DETROIT BUTT WELDING MACHINE

The type P butt welder which is illustrated and described herewith is manufactured by the Detroit Electric Welder Co., Detroit, Mich. The features of the machine are the extreme simplicity of construction combined with ease of operation, and a capacity for handling a wide range of work. The rated capacity is for welding together two pieces of iron ¾ inch in diameter, but the actual capacity is considerably greater.

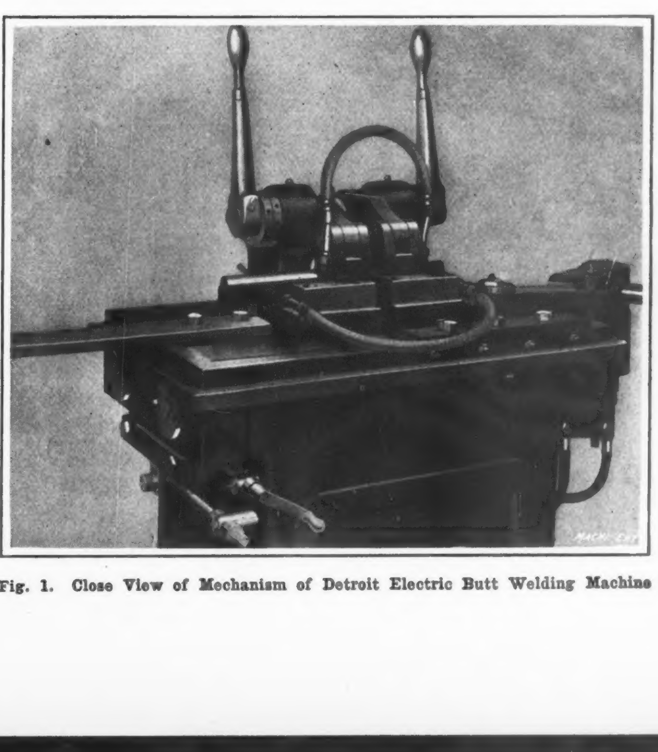


Fig. 1. Close View of Mechanism of Detroit Electric Butt Welding Machine

In addition to the welding of iron, the machine is also suitable for welding copper and brass.

One of the important features of this welder is the equalizing table with which it is equipped. By turning a handle, the table may be moved either horizontally or vertically to suit the convenience of the operator, thus permitting a careful adjustment of the electrodes and the production of a weld of the maximum efficiency. A stop is provided on the stationary frame of the machine so that the length of the metal on each consecutive operation is the same unless it is desired to be otherwise. The jaws and electrodes are both water-cooled, which insures the maximum life of these parts, and

Fig. 2. Detroit Type P Electric Butt Welding Machine

the clamping levers are adjusted to meet the requirements of different work by simply turning an eccentric bushing. The upsetting lever is provided with a similar form of adjustment. Eight heat controls are provided which furnish any required temperature.

UNITED STATES HAND MILLER

The hand milling machine that forms the subject of the following description is built by the United States Machine Tool Co., which is the machinery department of the United States Electrical Tool Co., Sixth Ave. and Mount Hope St., Cincinnati, Ohio. The design and features of the machine are apparent from the illustration, and for this reason the following description is confined to an outline of the principal dimensions and capacity of the tool.

The principal dimensions are as follows: Size of table inside oil grooves, 5 by 22 inches; maximum adjustment of table under spindle, 16 inches; maximum adjustment of table in line with spindle, 7 inches; maximum table feed with hand-lever, 6 inches; maximum table feed with crank, 16 inches; vertical lever feed of spindle head, 5 inches; size of T-slots, 5/8 inch in width; size of tight and loose pulleys on countershaft, 8 inches in diameter by 3¼ inches face width; diameter of pulley on back shaft, 6 inches; floor space occupied by machine, 27 by 37 inches; and net weight, 900 pounds.

The standard spindle furnished with the machine is bored No. 9 Brown & Sharpe taper, but spindles bored No. 10 Brown & Sharpe taper can be furnished to special order. It will be of interest to note that the top of the table can be brought on a level with the center of the spindle. The pulleys on the spindle end of the back shaft are interchangeable, and with a three-step cone pulley having steps 7, 8½ and 10 inches in diameter, six spindle speeds of 96, 138, 197, 268, 383, and 547 revolutions per minute are available. With a two-step cone pulley having steps 7 and 10 inches in diameter, four spindle speeds of 96, 197, 268, and 547 revolutions per minute are available. The cone pulleys on the countershaft and back shaft are of the same size.

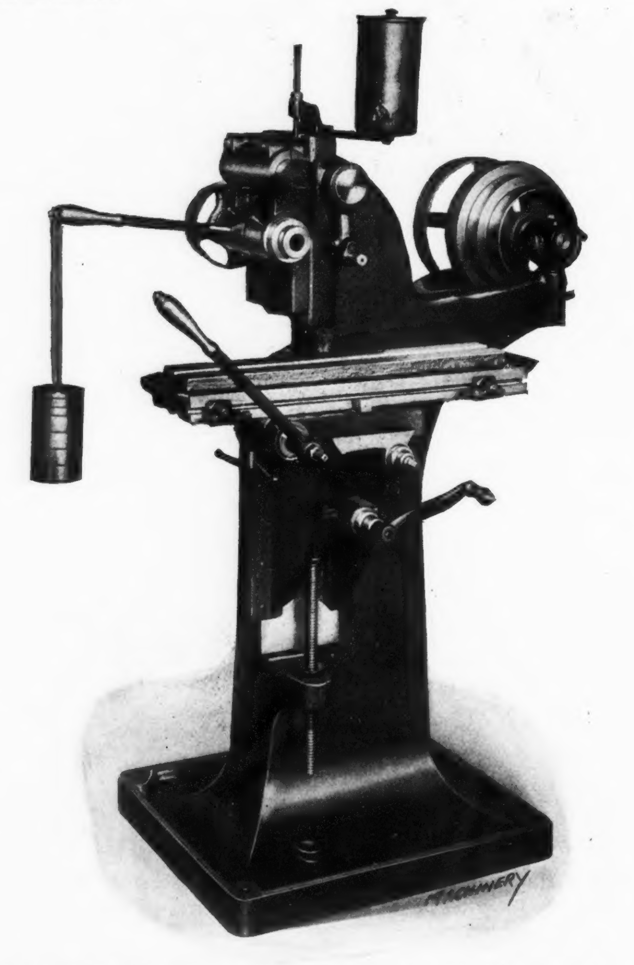
NEW MACHINERY AND TOOLS NOTES

Hydraulic Press: Mackintosh, Hemphill & Co., Pittsburg, Pa. This machine was designed and built for the Knox Pressed and Welded Steel Co., Wheatland, Pa. It has a pressure capacity of 400 tons and weighs 160,000 pounds.

Cutting-off Machine: Etna Machine Co., Toledo, Ohio. A heavy-duty machine adapted for cutting off solid and tubular stock up to 5 inches in diameter. The stock is held in a push-in collet which is bushed down to hold different sizes of work.

Scrap Baling Machine: Tempus Reclaiming & Mfg. Co., 25 N. 7th St., Philadelphia, Pa. A hydraulic machine for use in baling sheet metal scrap, which produces bales of square cross-section by the application of pressure at the top and at one end.

Irregular Curve Ruler: Keuffel & Esser Co., Hoboken, N. J. A flexible ruler for irregular curves. The ruling edge is made of black xylonite and a metal wire at the opposite edge provides for holding the ruler to the shape in which it has been set.



Hand Milling Machine made by the United States Electrical Tool Co.

Expansion Shield for Lag-screws: Diamond Expansion Bolt Co., 90 West St., New York City. A shield intended for use on lag-screws which are subjected to heavy loads. The shield enables screws to be placed in materials that do not afford a good grip for the threads.

Face and Tool Grinder: Mummert-Dixon Co., Hanover, Pa. This is a multiple-purpose machine. At one end there is an arbor which carries a coarse and a fine oilstone for use in sharpening cutting tools. At the other end of the machine there is a face grinding wheel for general grinding operations.

Forcing Press: Metalwood Mfg. Co., Detroit, Mich. A horizontal forcing press designed to give a high-speed stroke and quick return. The machine may be provided with belt drive, direct-current motor drive, or arranged for connection with an accumulator. The pump is of the duplex type with the body made of bronze.

Electric Welder: National Electric Welder Co., Warren, Ohio. A machine designed for the purpose of welding the ring section to the rim of pressed steel pulleys. In performing the welding operation one-half of the pulley rim is locked to a rotating carrier with the ring section and spokes in place, after which the welding operation is performed.

Planer Controller: Cutler-Hammer Mfg. Co., Milwaukee, Wis. A mechanical controller for use on planers equipped with reversing electric motor drive. The chief advantage claimed for the mechanical device is that it will be more readily understood by the average planer operator than an electrical device, and as a result it will receive the proper care and adjustment.

High-duty Lathe: Duff Mfg. Co., Pittsburg, Pa. A machine particularly adapted for turning work of small diameter. The swing over the saddle is 12 inches, and work may be turned which is of any diameter below 12 inches at approximately the most efficient cutting speed. The machine may be driven by a silent chain, it may be arranged for group drive from a common lineshaft, or a geared drive may be employed.

Shaft Straightening Press: Metalwood Mfg. Co., Detroit, Mich. A 50-ton press in which the work is held stationary; the cylinder and ram which apply the pressure are arranged to traverse along the bed of the machine to apply the load at any required point. The machine is provided with a hand-operated pump with automatic release, and the up and down movement of the ram is controlled by air pressure. The ram has a stroke of 8 inches and the maximum distance between centers is 72 inches.

Manufacturing Lathe: William B. Mershon & Co., Saginaw, Mich. A lathe designed to meet the requirements of manufacturing plants in which the use of heavy speeds and feeds is the rule. The swing over the bed is 22 inches, and over the carriage 14 inches; the distance between centers for an 8-foot bed is 3 feet, 8 inches. A silent chain drive is ordinarily provided for transmitting motion to the feed, but a belt may be substituted if desired. The weight of the machine with an 8-foot bed is approximately 4000 pounds.

Single-purpose Lathe: Duplex Printing Press Co., Battle Creek, Mich. A machine developed to meet the requirements of shell turning. The design follows conventional lines, the chief aim of the designer having been to produce a rigid machine capable of meeting the severe service conditions which exist in ammunition factories. Two quick changes of speed are provided by the gear-box, and there are four changes of feed. The swing over the bed is 19 inches and the swing over the carriage 11½ inches. The capacity between centers is 34 inches.

Bench Milling Machine: Bickett Machine & Mfg. Co., 1110-1112 Richmond St., Cincinnati, Ohio. A tool designed for splining and milling small parts at high speed. Such products as parts of rifles, revolvers, automatic machines, typewriters and sewing machines may be very satisfactorily handled on this bench miller. The spindle is made of high carbon steel, ground all over, and mounted in ball bearings which are provided with dust-proof covers. Both the table and knee are provided with adjustable stops and the cross-feed knob is graduated to read to 0.001 inch.

Friction Clutch: Bicknell-Thomas Co., Greenfield, Mass. A combination friction clutch and pulley which has been designed with a view to avoiding unnecessary weight and to secure easy operation. Other features of the design are the provision of means for making adjustment for wear and the development of a construction of extreme simplicity. The body is keyed to the shaft and held in position by hollow set-screws; it carries two friction shoes which work on the inner surface of the rim. Clutches of this type are made in capacities ranging from 4 to 12 horsepower at 100 R. P. M.

Electric Cylinder-seam Welding Machine: Toledo Electric Welder Co., Langland & Knowlton Sts., Cincinnati, Ohio. A motor-driven seam welding machine designed for the purpose of rapidly welding the seams of cylinders made of sheet steel or lead coated stock. It has a capacity for welding a 12-inch seam in five seconds, and working at this rate of production the machine leaves a perfectly smooth surface which is ready to be enameled or finished in any other way. The joint is water- and gas-tight. To obtain the required accuracy when producing duplicate parts, gages are furnished to enable the operator to turn out product of the required dimensions.

Band Turning Machine: Traylor Engineering & Mfg. Co., Allentown, Pa. A machine for forming the copper rifling bands on shrapnel and high-explosive shells. The work is held by a positive opening and closing chuck operated by compressed air. Control is afforded by a lever placed in front of the machine. The forming of the copper band is done with two tools which work successively. The capacity is for shells ranging from 2 to 6 inches in diameter and an idea of the rate of production will be gathered from the fact that the band on two 18-pound high-explosive shells has been completed in 50 seconds. Production can be maintained at the rate of 100 shells per hour.

ACCIDENTS AND HEALTH

Protection of the worker against ill health as well as accidents is a new extension of the safety movement that is being promoted by the American Association for Labor Legislation, whose headquarters are at 131 E. 23rd St., New York City. This extension, according to the association, can be brought about most effectively through a comprehensive health insurance measure. Instead of placing all the burden upon the employer, as the workmen's compensation laws have done, the bill for health insurance drafted by the association proposes to distribute the cost between the employer and workmen and to obtain a subsidy of one-fourth the total from the state. When the bill becomes a law, all manual workmen and others earning less than $100 a month will receive medical care and sick benefits for not more than twenty-six weeks of sickness in a year. The wife will receive special attention at childbirth and the family will be assured of medical care and a small funeral benefit upon the death of the wage earner. It is believed that such a measure will not only protect the workers when ill, but it will also call attention to the possibility of preventing sickness, just as fire and accident insurance have stimulated preventive measures in these fields. Employers and others interested in the proposed legislation should obtain from the association a copy of *Health Insurance*.

* * *

CARPENTER THREADING DIE-HOLDERS

The holders shown in Figs. 1 and 2, which are for use on threading dies and mills or other tools made in the form known as prong, spring or acorn dies, are a recent product of the J. M. Carpenter Tap & Die Co., Pawtucket, R. I. Tools

Fig. 1. J. M. Carpenter Threading Die-holder which supports Outer Ends of Prongs

made in this form have been defective to a certain extent from a lack of support near the outer ends of the prongs where the work is being done. The illustration of the two dies

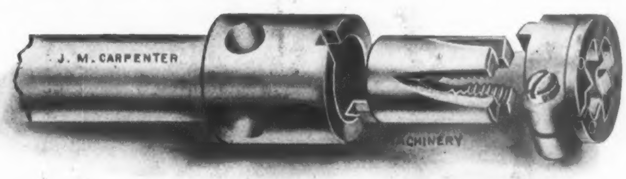


Fig. 2. A Simpler Form of the J. M. Carpenter Threading Die-holder

shown in Fig. 3 is proof of this statement, as this illustration was made from dies that were twisted in the condition shown here from actual use, showing a lack of support on each land or prong. These die-holders, which were patented September 28 and November 9, 1915, give this much needed support by placing dogs or stops on the adjustable rings which are locked firmly to the holders. These stops engage with the prongs near the outer end on the back side of same, thus holding the prongs firmly in place while they are under the strain of cutting. The acorn die was first brought out by J. M. Carpenter many years ago and was patented May 12, 1896.

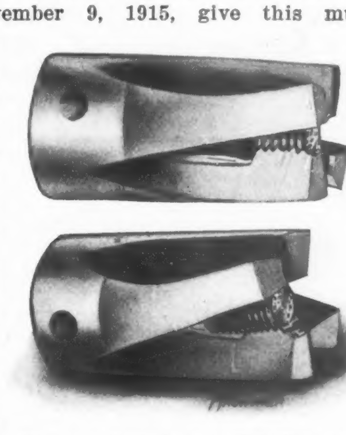


Fig. 3. Examples of Threading Dies bent through Lack of Support at Outer Ends of Prongs

DEPOSITED COPPER PARTS

There are many parts that are generally made from sheet copper in which the presence of a seam of any kind is undesirable, but in methods of manufacture that have been commonly employed—particularly in the case of tapered parts or pieces where one tube surrounds another—the presence of a seam in the work is a practical necessity. In attempting to develop a method of manufacture that would avoid the necessity of having a seam in the work, it became evident that the development of some method of depositing the copper electrolytically would constitute an ideal means of overcoming the difficulty.

The method employed by pioneers in this work consisted of making a wax core of the shape and size of the interior of the part that it was desired to make. This core was then made one of the terminals of an electrolytic cell containing a solution from which copper would be deposited on the core. A film of any desired thickness could be obtained by continuing the operation for a sufficient length of time. Although the method just described afforded a means of producing seamless parts, the use of the wax core had two serious drawbacks. First, it was found difficult to deposit the copper uniformly on the core; in many cases the metal was found to vary considerably in thickness, and in extreme cases there were small holes extending right through the metal. Second, it was found that the copper deposited on the wax core possessed a relatively low tensile strength.

These limitations of the process suggested the possibility of further improvement and the Cobal Co., Inc., 29 Thirteenth St., Long Island City, N. Y., has developed a method by which the objectionable features of depositing the copper on a wax core have been eliminated. It consists of employing a die-cast white metal core in place of wax, as the results of experiments have shown that copper deposited on the metal core will be of uniform thickness and that the strength of the metal will be materially greater than in cases where the deposit is made on wax.

The illustrations show examples of parts made by the Cobal Co., and will give an idea of the scope of the process. This is particularly true in the case of the manifold for an automobile engine, illustrated in Fig. 2, which shows what complicated parts can be made. The cross-sectional view in this illustration shows an example of a compound tubular structure. In producing such a part, a core is first made for the inner tube and the copper shell is deposited on this core in the usual way. Then a second core is cast around the inner tube to provide for depositing copper to form the outer tube. On parts of the general type shown in Fig. 2, the flanges are made separately and electrically welded to the ends of the tubes. In all cases, after the copper has been deposited, the work is put in a heating furnace where its temperature is raised sufficiently to melt the white metal core so that it may be poured out of the copper tube. As the melting point of white metal is approximately 600 degrees F. while that of copper is 1981 degrees F., it will be evident that it is an easy matter to melt the white metal without bringing the copper anywhere near the melting temperature.

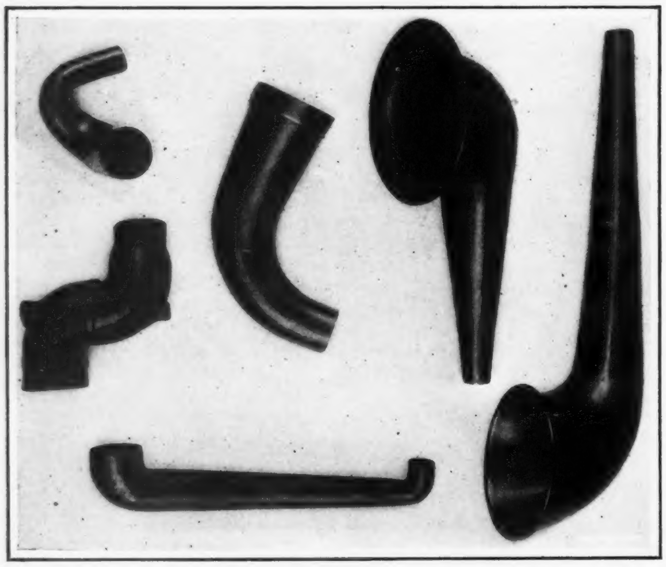


Fig. 1. A Few of the Parts which the Cobal Co. is making by Electrolytic Deposition of Copper

Among the parts of the products which the Cobal Co. is making by this method, the following may be mentioned: water jackets for gas engines, water-jacketed gas intakes for gas engines, tapered fittings, elbows, copper-coated steel wire and rollers, announcer horns, fittings and tubing for phonographs, incubator parts, etc.

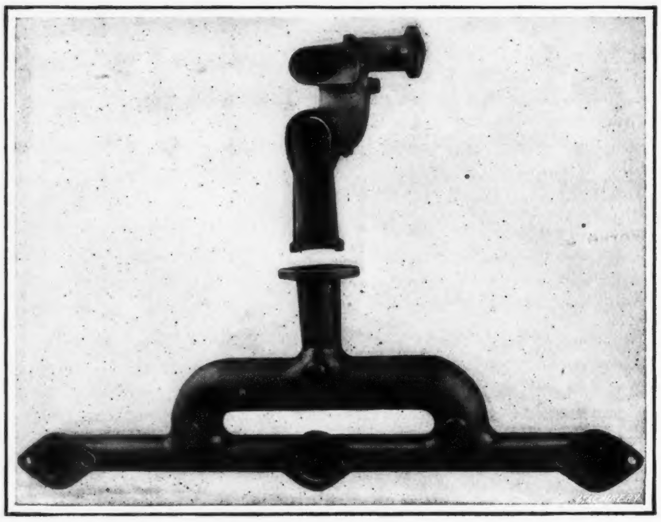


Fig. 2. Case in which Double Tubular Structure is produced by Electrolytic Deposition of Copper

* * *

NEW YORK ANNUAL AUTOMOBILE SHOW

The fifteenth annual automobile show held at the Grand Central Palace, New York City, from December 31 to January 8, inclusive, brought together a notable exhibit of products of the leading manufacturers of motor cars and accessories throughout the country. This annual motor show is an event of national importance. It places before the buying public the new products of an industry that in a few years has become third in importance in the manufacturing of the United States, steel and cotton being first and second.

Four floors of the Grand Central Palace were required to provide space for the cars and accessories. On the ground and mezzanine floors, the space was given over to complete cars and chassis. In many cases the chassis and engine parts were cut out in such a manner as to show the operation of the engine, transmission and other parts to advantage. On the third and fourth floors were shown motor car accessories. These, from the mechanic's point of view, were probably the most interesting, as many novelties were included, and the construction of the devices shown were in many cases made clear by sectional cuts or disassembled parts. A noteworthy feature of the exhibit was the large number of attractive two- and five-passenger cars, ranging in price from about $650 to $900.

During the past year there has been much discussion of eight, and twelve-cylinder automobile engines. Although a multiplicity of cylinders has advantages, it also has disadvantages, and while a number of cars shown were of the eight- and twelve-cylinder types, most of the leading models were of the six-cylinder type. It is apparent from the exhibition of cars that the standard by which the automobile engineers measure an engine is its power, cost of production and cost of operation rather than by the number of cylinders. According to this standard, the six-cylinder engine is probably equal if not superior to all others. The eight- and twelve-cylinder cars in use apparently give satisfactory service, but if the 1916 show is a criterion, the six-cylinder car is here to stay. The high-priced car of four or five years ago, having an engine of twenty-five to thirty horsepower, has been developed into a car that averages fifty horsepower and costs considerably less than $2000 fully equipped. In fact, the equipment

is more complete than that furnished a few years ago with cars of double the price, and much of the special equipment formerly found only on high-priced cars is now a feature of the less expensive makes.

Another prominent feature was the limousine or all-year-round body. This type has, in the past, been obtainable only in the most costly cars, but now there are several cars with limousine bodies sold for less than $1000. The motor car has proved its usefulness as an all-year car rather than a summer luxury. Several companies have been formed during the past year for the purpose of making limousine bodies for all makes of cars and have apparently found a ready market for their product. A large part of the motor car builders now provide either permanent or detached limousine bodies, and this development is likely to make motor cars even more popular with those who use them for business purposes in winter.

The most prominent features apparent to the casual observer at the show were the increased power of the engines, simplification and reliability in power equipment, improved appearance of the bodies and the large reduction in cost of well known makes. As to engine design, it may be said that the best makes with few exceptions have standardized the six-cylinder small-bore, long-stroke engine having a power capacity of about fifty horsepower. The weight of the cars has been greatly decreased by the use of alloy steels and aluminum alloys in cylinders, crank casings, pistons, etc. In most respects the present $2000 cars are superior to cars built four or five years ago at any price.

* * *

NATIONAL-ACME MFG. CO. PURCHASES WINDSOR MACHINE CO.

The National-Acme Mfg. Co. has acquired the plant of the Windsor Machine Co., Windsor, Vt., and the present intention is to continue the Cleveland, Montreal and Windsor plants of the National-Acme Mfg. Co. along the lines heretofore followed with a view to expanding them as rapidly as conditions seem to warrant. It was voted at a special stockholders' meeting held in Cleveland, January 20, to increase the capital stock from $2,500,000 to $9,000,000 ($7,500,000 common and $1,500,000 preferred) for the purpose of providing funds for an extension at Cleveland which is about complete, for contemplated improvements at Montreal, and to provide in part for the purchase of the Windsor property. The price paid for the stock of the Windsor Machine Co. was $3,575,000 or $1100 per share.

* * *

CENSUS OF MANUFACTURERS

An organization is contemplated consisting of representatives of the American Society of Mechanical Engineers, American Institute of Electrical Engineers, American Society of Civil Engineers, American Institute of Mining Engineers, and American Chemical Society, to collect data of the machine shops and factories of the United States that might be available for the manufacture of munitions of war in case of an emergency. President Woodrow Wilson, in a communication to W. L. Saunders, president of the American Institute of Mining Engineers, expressed hearty sympathy with the idea, regarding it as a patriotic service. The board of engineers suggested by the president will comprise a representative member of each of the five societies in each of the forty-eight states of the Union, which means a national board of 240 engineers. Behind these men will be the combined membership of the societies which totals more than 38,000 mechanical, electrical, civil, mining, and chemical engineers.

Mr. Saunders states that a preliminary census of the industries of New Jersey was made, including every factory and plant, large and small, which, after elimination, was found to include about 800 factories that produce things which would be needed in the event of war. The plan, if carried out for the entire nation, would give the government complete data as to the resources of each and every factory, the nature of its activities and what materials it would be best prepared to furnish. The value of such a national mobilization of manufacturing resources in a great emergency could hardly be overestimated.

JOHN A. HILL

John A. Hill, president of the Hill Publishing Co. and principal owner of the *American Machinist*, who died suddenly of heart disease on January 24, was a fine example of the typical American who from modest beginnings has risen by inherent ability and energy to a commanding position of honor and wealth. Mr. Hill was born in Vermont, February 22, 1858, and taken West by his parents when a small boy, first to Wisconsin, later moving in a "prairie schooner" to the plains. He returned to Wisconsin when a lad and worked for six years in a printing office. Later he took up the study of mechanics, working as a machinist in Colorado, and at the age of twenty was a locomotive engineer on the Denver & Rio Grande Railway, engaged in the work of extending the line through the Rocky Mountains. In 1885 he turned to newspaper work, and for about a year was editor and one of the owners of the *Pueblo Press*, which he left to return to railroading, where he remained until 1887. During those years some of his spare time was given to writing for the *American Machinist*, and his articles were so highly regarded that in 1887 he was offered a position as editor of the *Locomotive Engineer*, publication of which was begun by the *American Machinist* in that year, and which he and Angus Sinclair bought in 1891, changing the name to *Locomotive Engineering*. In 1896 the two partners also bought control of the *American Machinist*, and on the dissolution of their partnership a year later, Mr. Sinclair took *Locomotive Engineering* and Mr. Hill the *American Machinist*. He rapidly increased the income and value of his journal, and in 1902 was able to buy *Power*, which was the leading periodical in its field. Three years later he acquired the *Engineering and Mining Journal* and in 1912 the *Engineering News*. Then he began the publication of the *Coal Age* and recently bought the *Colliery Engineer* and consolidated the two. In 1902 Mr. Hill merged all his publishing interests in the Hill Publishing Co., capitalized at $1,000,000. One of Mr. Hill's cherished ambitions was realized in 1914 by the erection of a modern twelve-story fireproof printing building to house his publications, at Tenth Ave. and Thirty-sixth St., New York City, which included many original ideas for a structure devoted to that business. Mr. Hill was a man of strong and attractive personality and unbounded energy; generous, warm-hearted and a good friend. He leaves a widow and one daughter, Miss Jean C. Hill.

* * *

PERSONALS

Victor Brook, tool designer for the Arrow Electric Co., Hartford, Conn., has joined the editorial staff of MACHINERY.

R. W. Johnson, superintendent of the Emil Grossmann Mfg. Co., Inc., Brooklyn, N. Y., has resigned to take the position of factory manager with the Weiner-Barnet Co., Newark, N. J.

William H. Carpenter, formerly superintendent of the East

Speed and Accuracy in Producing Both Spur and Bevel Gears

and securing these results with one machine are conditions possible in a shop equipped with the machine shown below. There are many shops having occasion to use a variety of sizes of both spur and bevel gears that have not sufficient quantities of each to warrant the expense of installing machines to cut each type. Their requirements demand an accurate and efficient machine that will cut both kinds—a machine that operates rapidly and can be set up to handle small lots with a minimum loss of time. With such a machine a shop can handle its own gear cutting with very satisfactory results.

Brown & Sharpe No. 13 Automatic Gear Cutting Machine

offers an economical solution of the problem of handling a variety of gear cutting.

Like our line of Spur Gear Machines it is rapid in operation, easy to set up, and, having an accurate indexing mechanism and a smooth, powerful drive, it is capable of producing correct gears at profitable rates of production.

The cutter carriage is adjustable to any angle to 90° and once set can be rigidly clamped. An arc graduated to half degrees indicates the angle of elevation, facilitating an accurate setting for any required angle. The machine can be used to good advantage for cutting clutches, indexing being rapid and automatic, thus effecting a big saving in time over the ordinary method of handling.

Cutting straight teeth on slitting saws and milling cutters, end teeth on end mills, side teeth on milling cutters, are other profitable applications of this versatile machine. You should investigate its possibilities in your shop. It can be kept busy on a variety of work, a lot of which perhaps is now being handled outside your shop. Details of construction and operating features are fully described in our circulars. Write for one now.

Brown & Sharpe Mfg. Co.,

OFFICES:. 20 Vesey St., New York, N. Y.; 654 The Bourse, Philadelphia, Pa.; 626-630 Washington Blvd., Chicago, Ill.; 305 Chamber of Commerce Bldg., Rochester, N. Y.; Room 419, University Block, Syracuse, N. Y.

REPRESENTATIVES: Baird Machinery Co., Pittsburgh, Pa.; Erie, Pa.; Carey Machinery & Supply Co., Baltimore, Md.; E. A. Kinsey Co., Cincinnati, O.; Indianapolis, Ind.; Pacific Tool & Supply Co., San Francisco, Cal.; Strong, Carlisle & Hammond Co., Cleveland, O., Detroit, Mich.; Colcord-Wright Machinery & Supply Co., St. Louis, Mo.; Perine Machinery Co., Seattle, Wash.; Portland Machinery Co., Portland, Ore.

Bristol brass mill of the Bristol Brass Co., Bristol, Conn., has been appointed manager of the Mayo Radiator Co. of New Haven, Conn.

Norman B. Chase, for many years superintendent of the Cincinnati Shaper Co., Cincinnati, Ohio, has resigned the position to become vice-president and general manager of the Fosdick Machine Tool Co. of Cincinnati.

Charles F. Scribner, formerly production engineer with the Colt's Patent Fire Arms Mfg. Co., Hartford, Conn., has joined the Cleveland Twist Drill Co., Cleveland, Ohio, to fill the position of assistant superintendent.

C. H. Handerson has succeeded A. E. Coburn as advertising manager of the Cleveland Twist Drill Co., Cleveland, Ohio. Mr. Coburn resigned to take the position of advertising manager of the Maxwell Motor Co., Detroit, Mich.

Martin G. Sperzel has resigned his position as sales engineer for the Standard Roller Bearing Co., Philadelphia, Pa., and has taken a similar position with the Royersford Foundry & Machine Co., 54 N. 5th St., Philadelphia, Pa.

L. W. Coppack has been made sales manager for the Plank Flexible Shaft Machine Co. of Grand Rapids, Mich. Mr. Coppack will travel extensively in the interests of the company, selling flexible shafts and universal joints.

Paul R. Ketzer, formerly connected with the Watson-Stillman Co., New York, has been appointed eastern manager in charge of sales of the Metalwood Mfg. Co., Detroit, Mich., with an office in the exhibition department of the Philadelphia Bourse.

Leslie B. Stauffer was elected secretary of the Warner & Swasey Co., Cleveland, Ohio, at the recent annual meeting of the stockholders. Mr. Stauffer, who has been with the company seventeen years, started as a clerk in the factory. He succeeds Frank A. Scott who has been made vice-president.

Alfred P. Mello, formerly of the Westinghouse Co., Springfield, Mass., has been appointed chief engineer and superintendent of the Davis Arms Co., Boston, Mass. This company is equipping a large plant for the manufacture of military rifles and expects by June to be turning out 1000 Spanish-Mauser rifles a day.

E. C. Waldvogel, who has been connected with the Yale & Towne Mfg. Co., New York City, for the past eleven years, and has successively filled the positions of traveling salesman, sales manager, and assistant general manager, has been appointed general manager. In addition to the regular duties which belong to his new office, Mr. Waldvogel will have general supervision of all domestic, Canadian and export sales.

A. S. Baldwin, works manager of the R. D. Nuttall Co. of Pittsburg, Pa., a large manufacturer of commercial cut gears, has resigned to take the position of manager of ordnance for the Poole Engineering & Machine Co. of Baltimore, Md. The Poole Engineering & Machine Co. has contracts approximating $19,000,000 with foreign governments for war munitions. Mr. Baldwin was for three years general manager of the Alberger Pump & Condenser Co., Newburg, N. Y.; four and a half years general superintendent of Driggs-Seabury Ordnance Corporation, Sharon, Pa.; and two years superintendent of the American-British Mfg. Co., at Bridgeport, Conn.

OBITUARIES

Asa S. Cook, president of the Asa S. Cook Co., Hartford, Conn., died January 13 of pneumonia. Mr. Cook left four children.

D. Lorenzo Stebbins, a large manufacturer of mowing machines, died at his home in Hinsdale, N. H., December 28, aged eighty-eight years.

Henry M. Geis, salesman for the Brown & Sharpe Mfg. Co.'s Chicago store, died at his home in Maywood, Ill., December 21, aged thirty-five. Mr. Geis left a widow and one son.

William B. Ruggles, head of the Ruggles-Coles Engineering Co., New York City, and for more than twenty years a prominent engineer, died at his home in Bergen Point, N. J., January 23, aged fifty-four years.

Benjamin M. Jones, president B. M. Jones & Co., Inc., Boston, Mass., died at his home in Boston, November 26, aged seventy-eight years. Mr. Jones, representing Samuel Osborn & Co., Sheffield, England, had the distinction of introducing to the metal-working industries of America, the well-known "Mushet" self-hardening steel in the early seventies, shortly after its discovery.

Prof. Ole N. Trooien, Brookings, South Dakota, died December 21, aged thirty-five. He graduated from the engineering department of the State College of Brookings and spent a year at the University of Wisconsin. His illness began with an attack of the bends in 1908 while employed as engineer in the construction of the Pennsylvania R. R. tunnels under the Hudson river. His thesis on steam engine design, written at the University of Wisconsin in 1907, is now largely incorporated in some of the mechanical engineering handbooks.

Robert H. Grant, a well-known expert in the manufacture of balls and design of ball-making machinery, died at his home in Ann Arbor, Mich., January 11. He was a graduate of the Fitchburg High School, Fitchburg, Mass., and the Fairchild Institute of Flushing, N. Y. His mechanical training was obtained with the Pratt & Whitney Co. of Hartford and the Simonds Rolling Machine Co., Fitchburg, where his father, John J. Grant, who built and equipped the first ball-bearing factory, was superintendent. With his father, Mr. Grant organized the Grant Anti-Friction Ball Co., which was later consolidated with the Cleveland Machine Screw Co. of Cleveland, Ohio. When the Cleveland Machine Screw Co. was sold to a French syndicate, Mr. Grant organized the Grant Ball Co. of Cleveland, which manufactured balls and screw machine products. Selling his interest in this company, Mr. Grant became superintendent of the Standard Roller Bearing Co. of Philadelphia, Pa., which at that time had only a small factory, employing fifteen men. Within three years the company acquired control of ninety per cent of the ball trade of this country and had built and equipped a plant covering several acres. After having been with the company eight years, Mr. Grant resigned and spent some years designing machinery and equipping plants for the manufacture of balls and ball and roller bearings. Mr. Grant was a valued contributor to MACHINERY. In the February, 1912, number he began a series of articles on the manufacture of steel balls and ball and roller bearings, which made public for the first time much valuable information on the theory and practice of ball making.

COMING EVENTS

February 21-26.—"Safety First" exhibit, under government auspices to promote safety in mining. A conference of state mine inspectors will be held at the office of the Bureau of Mines, February 24.

Sept. 11-16.—Annual convention of the American Foundrymen's Association and the American Institute of Metals, Cleveland, Ohio, in the Cleveland Coliseum. A. O. Backert, secretary-treasurer, American Foundrymen's Association, Cleveland, Ohio.

SOCIETIES, SCHOOLS AND COLLEGES

Yale University, New Haven, Conn. Catalogue of the Sheffield Scientific School for the college year 1915-1916.

Society of Automobile Engineers, 29 W. 39th St., New York City, at its annual mid-winter meeting, held in New York in January, elected the following officers: Russell Huff, president; Eugene E. Foljambe and Robert H. Combs, vice-presidents; Herbert Chase, treasurer; Edwin R. Hall, David Beecroft, John G. Utz and George W. Dunham, members of the council.

Motor and Accessory Manufacturers, 33 W. 42nd St., New York City, held its twelfth annual meeting in New York in January. F. Hallett Lovell, Jr., was elected president; C. W. Stiger, C. E. Thompson and T. J. Wetzel, vice-presidents; L. M. Wainwright, treasurer; and Alfred P. Sloan, Jr., secretary and assistant treasurer. William M. Sweet was continued as manager of the organization.

Association of Engineering Societies, St. Louis, Mo., organized in 1881, has been disbanded and the publication of the "Journal of the Association of Engineering Societies" has been discontinued. The Engineers' Club of St. Louis, the largest society in the association, has begun the publication of a bi-monthly journal, known as the "Journal of the Engineers' Club of St. Louis." The subscription price is $2 a year.

American Association for Labor Legislation, 131 E. 23rd St., New York City. Booklet entitled "Health Insurance," containing standards and tentative draft of a proposed health insurance act to be brought before the New York legislature at the present session. The Act will provide for the insurance of workers against ill health and will provide medical care and sick benefits for all workers receiving less than $100 a month for not more than twenty-six weeks sickness in a year. The cost will be distributed between employer and workman and the state.

American Electrochemical Society, 239 W. 39th St., New York City. The New York section of the American Electrochemical Society has arranged a symposium on "Electrochemical War Supplies" which it will hold jointly with the New York sections of the American Chemical Society and the Society of Chemical Industry at the Chemist Club, 52 E. 41st St., New York City, Friday evening, February 11. Lawrence Addicks will speak on "Electrochemical War Supplies;" W. S. Landis on "Air Saltpeter;" E. D. Ardery (U. S. Army) on "Hydrogen for Military Purposes;" Albert H. Hooker on "New War Products;" William M. Grosvenor on "Magnesium;" G. Ornstein on "Liquid Chlorine;" and George W. Sargent on "Electric Steel."

NEW BOOKS AND PAMPHLETS

Mechanical World Pocket Diary and Year Book for 1916. 429 pages, 4 by 6 inches. Illustrated. Published by Emmott & Co., Ltd., Manchester, England; distributed in the United States by the Norman-Remington Co., Baltimore, Md. Price, 30 cents.

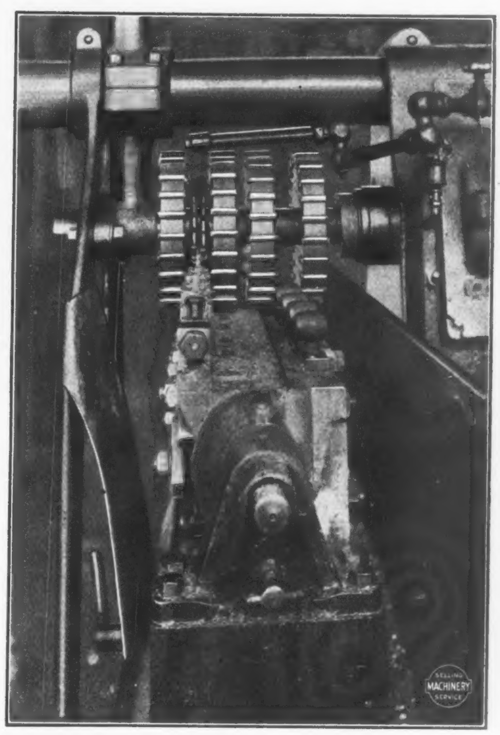
This collection of useful engineering notes, rules, tables and data, has been published by the "Mechanical World" for twenty-nine years, and is well known to the engineers of Great Britain and, to a lesser degree, in the United States. The section on steam boilers has been largely rewritten in this twenty-ninth edition and much additional information introduced on boiler mountings, etc. Some notes on brazing and soldering have been included and new tables regarding the Lancashire and Cornish boilers, dimensions of locomotive boilers, steel plates, friction clutches, circle spacing, etc. The little work is one that every engineer, designer, draftsman and mechanic should often find of use.

Mechanical Engineer's Pocketbook. By William Kent. 1526 pages, 4 by 6¾ inches. Published by John Wiley & Sons, Inc., New York City. Price, bound in leather, $5, net.

This well-known reference book of rules, tables, data and formulas was first published in 1895, and it now appears in the ninth edition, revised. The revision was accomplished with the assistance of Robert T. Kent. A review of the work as a whole would be superfluous, and it will be desirable only to state the changes that have been made since the eighth edition was published in 1910. Many engineering standards have been changed in this period which made a thorough revision of many sections of the work necessary. These changes involved over 400 pages and required the addition of over 150 pages of new matter. Chapters on many subjects in the earlier editions have been condensed in order to permit the insertion of new matter without increasing the size of the book to unwieldy proportions. The chapter on machine shop practice has been rewritten and doubled in size, and now covers many subjects omitted in earlier editions, including data on planing, milling, drilling and grinding, machine tool driving, etc. Among the new tables included are tables of square roots of fifth powers, four-place logarithms, standard sizes of welded steel pipe, standard pipe flanges, properties of wire rope, firebrick, properties of structural sections and columns, chemical stand-

Speaking of Spindle Power and Rigidity Consider this Operation

It consists in milling gas engine connecting rods, eight at a time. Rods are held in vertical position in a swinging jig, four on each side, and are milled on both ends. Four rods present the big end and four the small end to the six cutters at the same time. The milled surface across the big end is 2½″ diameter; small end 1¼″ diameter; ¼″ stock. There is also an oil wick extension on the large end which is milled with two cutters 4½″ x ⅝″. Four cutters are 10″ x 2″. They rotate 21 R. P. M., or 55.3 feet per minute; feed is 4¾″ per minute. Production is 32 rods per hour, *monthly average*.



The Cincinnati No. 2 Plain Miller

The above work is done by the Rutenber Motor Company, Marion, Indiana, on a Cincinnati No. 2 Plain Miller. The special feature in this operation which shows up "Cincinnati" rigidity is the height at which the cutters work from the clamped fixture and the entire absence of chatter marks from the finished work.

Give us the opportunity to show what "Cincinnati" Millers can do for you.

The Cincinnati Milling Machine Co.

CINCINNATI, OHIO, U. S. A.

ards for iron castings, flow of air, water and steam, power required for driving machine tools, both singly and in groups. The index has been amplified and is so arranged as to make quick finding of subjects easy. The general popularity of "Kent" is attested by the fact that the total issue is 108,000.

NEW CATALOGUES AND CIRCULARS

International Engineering Co., Cleveland, Ohio. Catalogue of tapping, countersinking and deep-hole drilling machinery.

G. M. Yost Mfg. Co., Meadville, Pa. Catalogue 7, giving dimensions and prices of universal machinists', blacksmiths' and wood-workers' vises.

W. J. Savage Co., Inc., Knoxville, Tenn. Circular of Gray's sheet metal cutter No. 1 for cutting sheets or plates up to and including 3/16 inch in thickness, with a reciprocating tool.

U. S. Machine Tool Co., Cincinnati, Ohio. Circular of No. 1 manufacturers' hand milling machine. The U. S. Machine Tool Co. is the machine tool department of the U. S. Electrical Tool Co.

Joseph Dixon Crucible Co., Jersey City, N. J. Booklet descriptive of Dixon graphite products, for lubricating cylinders, valves, bearings, slides, gears, chains, and all kinds of mechanisms.

General Electric Co., Schenectady, N. Y. Bulletin 43253, treating of series luminous arc lamps of the pendant type, showing the illumination obtained by these lamps on streets in various cities.

Armstrong Mfg. Co., 297 Knowlton St., Bridgeport, Conn. Circular of the Armstrong ratchet nipple threader for threading pipe in close places where ordinary die-stocks cannot be used.

Steel-Art Tool Co., Machinery Hall, Chicago, Ill. Catalogue 6 on "Satco" safety drill-holders, safety tool-holders, safety sleeve ratchets, live pipe center for lathes, boring-bars and bar holders, and safety lathe dogs.

Shepherd-Prince Co., Inc., 18 E. 41st St., New York City. Circular of the "Master" wrench, consisting of an alligator type wrench with one sliding jaw that adapts the wrench for all sizes of square and hexagonal nuts, pipe, etc., within its capacity.

Bickett Machine & Mfg. Co., Cincinnati, Ohio. Circular of "National" No. 0 hand miller for splining and milling small parts at high speed. Parts of rifles, revolvers, automatic machines, typewriters and sewing machines can be machined with great rapidity.

Joseph T. Ryerson & Son, Chicago, Ill. Circular of a pneumatic spring banding press, especially designed for railroad and commercial spring manufacturing and repair shops. The press exerts a pressure of sixty tons on the two rams with an air pressure of 100 pounds per square inch.

High-Speed Hammer Co., Rochester, N. Y. Catalogue of riveting hammers of the pedestal vibrating arm type, made in several styles and sizes. The machine delivers an elastic blow; the smallest machine has capacity for 3/16 inch rivets, and the largest is designed for 1/4 inch to 5/8 inch rivets.

General Ordnance Co., Denver, Colo. Bulletin of 22-inch heavy-duty single-purpose projectile lathe, having a swing of 22 inches over the shears and 13 3/4 inches over the carriage. This lathe is built with only two speeds; the ratios of the driving pulley to the spindle are, respectively, 1 to 5 and 1 to 3.

Newman Mfg. Co., 717-721 Sycamore St., Cincinnati, Ohio. Circular of Newman multiple rotary chuck for converting engine lathes into turret lathes at small cost; and "Spotlight" brackets with special guards, reflectors and shades for holding incandescent electric lamps in any desired position without danger of breakage.

Toledo Electric Welder Co., Langland and Knowlton Sts., Cincinnati, Ohio. Bulletin 17 containing information on heavy-duty spot welders. The various styles of welding machines for handling material of different gages are illustrated. Butt welding attachments for spot welding machines, seam welders and butt welding machines are also illustrated.

Simonds Mfg. Co., Fitchburg, Mass. Collection of twelve advertisements, entitled "Hacksaw-ology," giving a bit of history and touching on cutting-off methods, hacksaw teeth, set of hacksaw blades, steel and temper, cutting off stock by hand, cutting off stock with the power saw, lubricating hacksaw blades, cutting thin stock with hacksaws, why hacksaw lathes break, cutting tubing and rods and hacksaw blade economy.

Beaudry & Co., Inc., 141 Milk St., Boston, Mass. Catalogue on Beaudry belt- and motor-driven hammers which are built in two types, namely the "Champion" for light and heavy railroad, machine, and general forging, and the "Peerless" for plating, drawing, swaging, collaring, spindle making and general manufacturing. The "Champion" hammer is built in sizes from 50 to 500 pounds weight of ram, and the "Peerless" hammer is built in sizes from 25 to 200 pounds weight of ram.

Landis Machine Co., Waynesboro, Pa. Catalogue 22 illustrating Landis threading machinery and describing in detail the construction of the Landis die. Since issuing its last catalogue the company has perfected a line of pipe threading and cutting machines and has developed a grinder suitable for grinding Landis chasers. These machines are shown in the new 1916 catalogue. Those who have thread cutting to do will find the tables of U. S. S., V, and Whitworth threads, lag screws and cutting speeds for various diameters of bolts, of value.

Winter Bros. Co., Wrentham, Mass. Catalogue 11 of carbon steel taps and dies, and high-speed steel taps and dies, "Thistle" brand, containing lists of hand taps, nut taps, machine screw taps, tapper taps, pulley taps, hob taps, stove bolt taps, patch bolt taps, Beaman & Smith taps, hand screw chasers, staybolt taps, tap wrenches, boiler taps, pipe taps, adjustable round dies, die-stocks, square dies, spring screw threading dies, screw plates and tables of information. The catalogue is provided with a thumb index at the side which makes reference to any section quick and easy—a feature that should be much appreciated by those who have to consult it frequently.

Norma Co. of America, 1790 Broadway, New York City, has recently issued a particularly comprehensive catalogue—No. 105—on Norma precision ball and roller bearings. The first fifteen pages contain a general description of the construction of these bearings, and the next twenty pages go more into detail, stating the reasons for the specific points of design, and analyzing the principles of anti-friction efficiency with particular reference to Norma bearings. Sixty pages of tabular matter containing dimensions and prices of all the types of Norma bearings give an idea of the extent of the line. Following the tabular matter are several pages of drawings illustrating applications of these bearings that will be found of suggestive value by draftsmen and designers. The last section of the book treats of the selection of anti-friction bearings, and the suggestions contained therein should go far toward avoiding bearing troubles.

TRADE NOTES

Kearney & Trecker Co., Milwaukee, Wis., has changed the location of its Cleveland office from 313 Garfield Bldg. to 515 Garfield Bldg.

International Oxygen Co., 115 Broadway, New York, inaugurated the eight-hour day at its works in Newark, N. J., beginning January 1.

Welborne & Co., South Ferry Bldg., 44 Whitehall St., New York City, is a concern recently formed by W. E. Welborne for transacting business as purchasing agent, export and import agent and manufacturers' representative.

H. W. Caldwell & Son Co., 17th St. and Western Ave., Chicago, Ill., builder of conveying, elevating and power transmitting machinery, has opened a sales and engineering office at 711 Main St., Dallas, Tex., in charge of J. C. Van Arsdell.

Plank Flexible Shaft Machine Co., Grand Rapids, Mich., manufacturer of flexible shafts and universal joints, was burned out the last of December, sustaining considerable loss. The plant has been re-equipped and is now operating as usual.

Allied Machinery Co. of America, 55 Wall St., New York City, announces a change of address for its Paris office. The Paris office and show-rooms are now located at 19 Rue de Rocroy, in the vicinity of the Gare du Nord and in the center of the machinery district.

H. P. Townsend Mfg. Co., Hartford, Conn., maker of high-speed riveting machines, automatic screw machines, drilling machines and lathe taper attachments, has added several thousand feet of floor space to its plant to provide greater facilities for the manufacture of its machines.

U. S. Machine Tool Co., Cincinnati, Ohio, has been organized for the manufacture of machine tools. The officers are: J. A. Smith, president; William A. McCallum, vice-president; and G. H. Felter, secretary and treasurer. The new concern is an offshoot of the U. S. Electrical Tool Co., and has the same officers.

Royersford Foundry & Machine Co., 54 N. 5th St., Philadelphia, Pa., has built an additional warehouse and added two floors to its factory, which provide about 12,000 square feet, to be used for the assembling of 10-inch, 14-inch and 20-inch drilling machines, and emery grinders. This part of the company's business is growing very rapidly.

L. H. Gilmer Co., Philadelphia, Pa., has completed the first unit of its new factory in Tacony and has moved the office and manufacturing departments from 52 N. 7th St. to the new plant. Ground will be broken immediately for the second building unit, 50 by 200 feet. The company's business is rapidly improving and the prospects for future business are bright.

Doehler Die-Casting Co., Brooklyn, N. Y., and Toledo, Ohio, has placed contracts for its Toledo factory buildings to provide an area of 70,000 square feet of floor space, consisting of foundry, machine shops and offices. With these buildings completed, which are to be ready for occupancy May 1, the company will be in a better position than ever to give its Western patrons prompt and efficient service.

Keuffel & Esser Co., 127 Fulton St., New York City, has purchased the entire stock, furniture and fixtures, good will, trademarks, etc., of E. G. Soltmann, New York, who recently went into bankruptcy. The stock purchased was inventoried at more than $100,000. It included many of Soltmann's specialties that architects have been using for years and which Keuffel & Esser Co. will continue to market.

Worcester Lathe Co., 68 Prescott St., Worcester, Mass. A. W. Whitcomb, formerly of the Whitcomb-Blaisdell Machine Tool Co. and Charles E. Thwing, who for the past two years has been marketing the "Worcester" lathe, have joined under the name of the Worcester Lathe Co. for the purpose of continuing the manufacture of 11-inch and 13-inch "Worcester" lathes and to manufacture larger lathes and other machine tools.

Metalwood Mfg. Co., Detroit, Mich., has opened an office in the exhibition department of the Philadelphia Bourse, in charge of Paul R. Ketzer, eastern manager. Mr. Ketzer was formerly connected with the Watson-Stillman Co. and is well qualified to assume the duties of his new position by reason of his thorough knowledge of hydraulic engineering as well as through his wide acquaintance gained from extended sales experience in his territory.

Richardson-Phenix Co., Milwaukee, Wis., manufacturer of lubricators and oil distributing apparatus, has opened a branch office in Boston at 141 Milk St., in charge of Charles E. Blake. The New York office of the Richardson-Phenix Co. has been removed to 30 E. 42nd St. E. M. May, manager of the New York office, has associated with him J. J. May, who will devote his energies to the Richardson-Phenix "Nokut" valve department.

C. G. Buchanan Chemical Co., Cincinnati, Ohio, manufacturer of "Ferro-Case" hardening compound, has been obliged to secure larger quarters and has removed to 118 E. Pearl St., Cincinnati. The company will occupy all four floors of the building, and new apparatus has been installed; increasing the capacity about four times. It is hoped that the increased facilities will enable the company to keep abreast of the demands for its product.

Fosdick Machine Tool Co., Cincinnati, Ohio, builder of radial drills and horizontal boring machines, has been sold to a group of Cincinnati men. Norman B. Chase, for many years superintendent of the Cincinnati Shaper Co., is vice-president and general manager. There will be no change in the line of tools built or in the selling agencies. William Herman, who has been president and general manager of the concern, will retire from business on account of ill health.

R. E. Ellis Engineering Co., Chicago, Ill., has moved into offices at 202 Machinery Hall. The company is the local agent for the Hannifin Mfg. Co., Chicago, Ill., Kelly Reamer Co., Cleveland, Ohio, Murchey Machine & Tool Co., Detroit, Mich., and the Standard Electric Tool Co., Cincinnati, Ohio; and is selling agent for single-purpose lathes for turning large shells, etc. Mr. Ellis was formerly with the Chicago branch of Manning, Maxwell & Moore, Inc. and later with the Steinle Turret Machine Co., Madison, Wis.

Standard Pressed Steel Co., Philadelphia, Pa., manufacturer of steel shaft hangers and other pressed steel specialties, had a portion of its plant and its office destroyed by fire January 8. Concerns making machinery and supplies used by the company are invited to send copies of their latest catalogues and circulars to replace those destroyed. The company reports that rapid progress is being made toward resuming operations in full, and that it is able to continue making shipments in spite of the fire.

Bullard Machine Tool Co., Bridgeport, Conn., has placed a contract with the Turner Construction Co. for the erection of a reinforced concrete building, 268 by 50 feet, four stories high. The first story will be of "two-floor" height, and will be served by cranes operating in the two sections which run the entire length. The second and third floors will be utilized as machine rooms, while the fourth floor will be occupied by the management, shop executives and drafting department. The new building is to be ready for occupancy May 1.

Hoover Steel Ball Co., Ann Arbor, Mich., has let contracts for two additional manufacturing buildings and one office building to be erected immediately. These additions will increase the capacity of the forge and tempering department and the grinding department. They will be built of concrete and brick. These three buildings make a total of six additional buildings that have been added to the company's plant within about eighteen months. They afford a total manufacturing floor space of about 60,000 square feet.

American Metal Products Co., 3009-3021 Lisbon Ave., Milwaukee, Wis. At the annual meeting of the stockholders the old board of directors was re-elected, same being constituted as follows: Peter J. Weber, president; Henry C. Brelie, vice-president; William J. Eberle, secretary and treasurer; Richard Gaertner, general manager; and Charles E. Helm and August Littmann. The officers reported that although the present plant is being worked to full capacity it is impossible to keep up with the demand and many large orders are pending which absolutely necessitate the immediate installation of additional facilities, which the board voted should be provided.

Joseph T. Ryerson & Son, Chicago, Ill., tendered an annual Christmas dinner to the Ryerson salesmen and office executives of the Chicago plant at the Hotel La Salle, Wednesday evening, December 29. E. L. Ryerson, chairman of the board, and Clyde M. Carr, president of Joseph T. Ryerson & Son, were hosts. A story telling and musical program by talent within the house made the event very entertaining. During the Christmas holidays, Joseph T. Ryerson, treasurer, and W. H. Eulass, New York manager, acted as hosts for the house at a dinner of the sales and office organizations in New York City at the Hotel Astor. A. M. Mueller, St. Louis manager, was host at the dinner given his salesmen and office executives.

L. S. Starrett Co., Athol, Mass., issued a circular letter to its employes at Christmas time, stating that during the first seven months of 1915, with the exception of one month, its sales were slightly more than the sales of the corresponding months of last year. Beginning with August, the increase in business was greater, and on the whole, business during the year was very satisfactory. The company confined its activities to the production of mechanical tools and made no shells or other munitions of war. During the year, piece-work was instituted in various departments with success. The quality of work has been kept up, and those who are doing piece-work have averaged more than 25 per cent more pay than they would have received at day wages.